SJVN Arun-3 Power Development Company (P.) Ltd.

(A company promoted by SJVN Ltd.,
Joint Venture of Govt. of India and Govt. of H.P.)

Civil works of Tail Race Pond, outfall of Arun-3 HEP and Intake Structure with Tunnel located in Sankhwasabha Distt. of Nepal of

Arun-3 Hydro Electric Project

(900 MW)

Press Notice, NIT and Information for Bidders (IFB)	**Volume-0, Section-0**
Instructions to Bidders (ITB), Bid Data & Qualification forms	**Volume-1, Section-1**
General Conditions of Contract (FIDIC)	**Volume-2, Section-2**
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Data Sheets	**Volume-6, Section-8**

एसजेवीएन अरूण-3 पॉवर डवलपमेंट कंपनी प्रा. लि.
SJVN Arun-3 Power Development Company Pvt. Ltd.
(एसजेवीएन की पूर्ण स्वामित्व वाली अधीनस्थ कंपनी)
(A wholly owned subsidiary of SJVN)
900 मेगावाट अरूण-3 जलविद्युत परियोजना
900 MW Arun-3 Hydro Power Project
Regd. No.: 111808/69/070

PRESS NOTICE

Tender No.: DCB-P&C-AHEP-C-7/2023-103 **Date: 17.02.2023**

SAPDC invites bids on **Open Tender Basis** from eligible Indian/Nepalese Bidders through E-portal https://etender.sjvn.co.in/SRMLogin/SRMLogin.jsp for construction of following Civil Works package:

Contract Package Number	Description of Work	Cost of Bid Document	Bid Security	Completion Period
C-7	Civil works of Tail Race Pond, outfall of Arun-3 HEP and Intake Structure with Tunnel located in Sankhwasabha Distt. of Nepal.	NPR 10,000/- (For Nepalese bidders) or INR 7,000 equivalent to NPR 11,200/- (For Indian bidders)	INR 1,53,35,000/- (Indian Rupees One Crore Fifty Three Lakh and Thirty Five Thousand only) OR NPR 2,45,36,000/- (Nepalese Rupees Two Crore Forty Five Lakh and Thirty Six Thousand only)	09 Months

Last date for submission of bids is **10.03.2023 upto 1500 hrs (IST)** and opening of bids is **13.03.2023 at 1600 Hrs (IST)**.

The Bidding Documents can be downloaded from websites: www.sapdc.com.np, www.sjvn.nic.in & www.eprocure.gov.in and shall be available **w.e.f. 13.02.2023.**

Further, Amendments/Corrigendum /Notification (if any) shall be issued only on above website.

Chief Engineer (P&C)

SAPDC, Satluj Bhawan,
Tumlingtar, Distt. Sankhuwasabha, Nepal
Ph. +977-29-575154, 9852099789
E-mail Address: pnc.sapdc@gmail.com

NOTICE INVITING TENDER

Tender No.: DCB-P&C-AHEP-C-7/2023-103

1. SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC), is a company promoted by SJVN Ltd. as a single shareholder company in Nepal having its office at Satluj Bhawan, Arun Sadan, Tumlingtar, , Nepal (here-in-after referred to as "Employer").
2. *Deleted without change in Sr. No.*
3. SAPDC hereby invites sealed bids in single stage two envelope bid system on item rate basis from the competent Bidders/Contractors for construction of Works, as summarized herein below and described in Bid Document, hereinafter referred to as the "Works".

Contract Package Number	Description of Work	Cost of Bid Document	Bid Security	Completion Period
C-7	Civil works of Tail Race Pond, outfall of Arun-3 HEP and Intake Structure with Tunnel located in Sankhwasabha Distt. of Nepal.	NPR 10,000/- (For Nepalese bidders) or INR 7,000 equivalent to NPR 11,200/- (For Indian bidders)	INR 1,53,35,000/- (Indian Rupees One Crore Fifty Three Lakh and Thirty Five Thousand only) OR NPR 2,45,36,000/- (Nepalese Rupees Two Crore Forty Five Lakh and Thirty Six Thousand only)	09 Months

4. Indian bidders Or Joint Venture/Consortium of Indian firms Or Joint Venture/Consortium of Indian and Nepalese firms (Indian bidder as lead partner) meeting minimum Qualification Criteria are allowed to bid.
5. Bidders should not have been banned/ de-listed/ black listed/ debarred from business by Government of Nepal or any of its Government Department during last 03 (three) years on grounds of corrupt/fraudulent practices and/or due to non-performance and/or by Ministry of Power, Government of India/SJVN/SAPDC on any grounds.
6. The number of JV partners allowed for bidding is two.
7. The minimum qualifying requirements are as under:

7.1 Technical Criteria

7.1.1 General Construction Experience

The Bidder as Sole Contractor or Partner of a Joint Venture/Consortium or Sub-Contractor approved by the respective employer, should have experience of executing (includes completed and ongoing projects) a Works Contract of value at least INR 72 Crore in the preceding 15 years.

7.1.2 Specific Criteria

(a) Experience of executing (includes completed and ongoing projects) at least one civil work involving excavation / earth work of 1,03,000 m^3 or more in a single contract in last 20 years.

(b) Experience of achieving progress rate of execution of at least 1,03,000 m^3 excavation / earth work for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years.

(c) Experience of executing (includes completed and ongoing projects) at least one civil work involving concrete quantities of 30,900 m^3 or more in a single contract in last 20 years.

(d) Experience of achieving progress rate of execution of at least 30,900 m^3 of concrete quantities for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years.

7.1.3 Technical Experience

The Bidder as Sole Contractor or as Partner of JV or Sub-contractor approved by the Project Developer, should have executed following works in an ongoing/ completed project during the preceding 20 years. The end date of completion of work should fall within the preceding 20 years reckoned from the last day of the month previous to the one in which NIT is invited.

i) Completion of tunnel of minimum 50 m length and 8m finished dia. with Drill and Blast Method. Completion of tunnel means completion of excavation and lining of at least 50 m length and 8m finished dia. Tunnel

ii) Open/underground excavation having quantity 1,03,000 m^3 in any single Hydro Electric project.

Notes for clause no. 7.1:

i. Experience of above different activities / sub-activities / components need not to be from the same project.

ii. Concrete quantity shall include shotcrete quantity also.

iii. Experience of self or JV/ Consortium partner or parent company will be admissible. For JV/Consortium provision of relevant clause of contract shall apply.

iv. In case of ongoing projects, the value of completed work done shall be considered for the purpose of qualifying criteria.

v. The period of 15/20 years as above shall be reckoned from the date of issue of NIT. If the work for which experience is being claimed has been completed in last 15/20 years period, even if it has started earlier, the same shall be considered.

vi. Experience certificate from employer and Work Order/Contract Agreement indicating the scope of work should be submitted alongwith the bid to substantiate the experience in all cases.

7.2 Financial Criteria:

i) Submission of audited balance sheets or if not required by the law of the Applicant's country, other financial statements acceptable to the Employer, for the last three years to demonstrate:

(a) The net worth shall be positive in two years out of the last three immediately preceding financial years. However, the Net Worth of the immediately preceding financial year shall be positive. The Net worth shall be calculated based on paid up Share Capital plus Securities Premium Account plus all reserves created out of the profits plus Unallocated Balance/ Surplus amount of Profit and Loss Account, less (a) deferred Expenditure and Miscellaneous Expenditure not written off, (b) Accumulated losses in Profit and Loss Account, if not reduced from reserves and surplus. The reserves created out of revaluation of assets, write-back of depreciation and amalgamation will not be included while calculating Net Worth, and

(b) Capacity to have a Cash Flow Amount/Working Capital of at INR 32 Crore or equivalent as evident from the immediate preceding financial year as per the audited Balance Sheet / equivalent Financial Statements. Working Capital/Cash Flow amount shall be submitted as a difference of Current Assets and Current Liabilities, duly certified by Statutory Auditor/ a practicing Chartered Accountant.

Notes:

a. Banking reference should contain in clear terms the amount that the Bank will be in a position to lend for this work to the applicant / member of the Joint Venture. In case the Net Working Capital (as seen from the Balance sheet) is negative, only the Banking reference(s) will be considered, otherwise the aggregate of the Net Working Capital and submitted Banking reference(s) will be considered for working out the Working Capital.
b. The Banking reference(s) should be from a "A" Class Nepalese Bank/Scheduled Bank of India and it should not be more than 3 months old as on the date of submission of applications.
c. In case the applicant is a Joint Venture and if Banking reference is issued by the Bank in favor of the Joint Venture for this contract, then it will be considered for the applicants and if Banking reference is issued in favor of any member of Joint Venture, it will be considered only for that member.
d. In case of JV- requirement of working capital/net cash flow is to be distributed between members as per their percentage participation and every member should satisfy the minimum requirement for his portion.

ii) **Average Annual Construction Turnover:** Minimum Average Annual Construction Turnover shall be INR 72 Crore or equivalent for the immediate preceding two consecutive financial years.

General Notes for clause 7.2:

i. Sub-Contractor's financial parameters shall not be considered for working out Net Worth, Average Annual Construction Turnover and Working Capital of the Bidder.

ii. Construction Turnover duly certified by Statuary Auditor/ a practicing Chartered Accountant of the bidder/partner shall only be taken into consideration for evaluation purpose.

iii. Turnover of the applicant/partner from the related business i.e., Construction Turnover shall only be taken into consideration for purpose of evaluation. In case Construction Turnover is not shown separately in the financial statements, a certificate from Chartered Accountant certifying Turnover from Construction shall be submitted.

iv. Annual Report comprising audited Balance Sheets, Profit & Loss Accounts, the schedules and other Financial Statements of the immediate preceding three (3) years should be furnished by the bidder for evaluating the requirement stipulated hereinabove.

v. Immediate preceding financial year shall be the financial year ending six months before the last date of submission of Bids. For example, if the last date for submission of bids is between 1st April 2022 to 30th September, 2022, then the immediate preceding financial year shall be 2021-22 in case the Board has not approved the annual accounts for year 2021-22. In this case a statement to the effect that Board has not approved the Annual Accounts for the FY 2021-22 must be included in the requisite Statutory Auditor / CA Certificate(s).

   In case board has approved the annual accounts for financial year 2021-22, then bidder has to submit such account and the year 2021-22 shall be taken as immediate preceding financial year. Similarly, where the last date for submission of bids is between 1st October, 2022 to 31st March, 2023, then the immediate preceding financial year shall be 2021-22.

vi. In case where Audited financial results for the immediately preceding year are not available, then a statement of account as on the closing date of the immediately preceding financial year depicting the Turnover, working capital and Net Worth (calculated as per laid down criteria) duly certified by their Statutory Auditor/ Certified Public Accountant carrying out the statutory audit shall be enclosed with the Bid along with copy of appointment letter of the Statutory Auditor.

vii. Wherever, the Annual Report/ duly notarized copies of Audited Printed Annual Financial Statement are in language other than English, then copy duly translated & printed in English language and certified by approved/ recognized English translator shall be submitted with the Bid.

viii. Equivalent financial statement shall mean the financial statement which is to be prepared as per the law of bidder's country.

ix. For the purpose of compliance of the stipulated turnover criteria given at Financial Criteria, the construction turnover from JV/Consortium(s) as declared in the Joint Venture/Consortium Agreement shall also be considered. The proportionate JV/Consortium turnover shall be certified by their statutory auditor if the same is not appearing in Audited Financial Statement.

x. For conversion from INR to NPR and vice versa, a factor of 1.6 will be considered.

7.3 Bid Capacity

The available Bid capacity of the Bidder for the participation in the present tender, calculated as under should not be less than INR 144 Crore.

Available Bid capacity = 2.0 x A x N - B

Where;

A= Indexed value of maximum value of works executed (in an on-going or completed project) in any one year during last 20 years, keeping index of inflation as 6% (compounded annually) for calculating A at present Price Level.

N = Number of years prescribed for completion of the subject contract package

B = Value of existing commitments (as on bid submission date) and on-going works to be completed in next "N" years.

Note: The information related to the maximum value of works executed in any one year during the last 20 years and existing commitments including ongoing works shall be supported with a certificate from the Statutory Auditor/ a Chartered Accountant firm.

8. The Employer will award the contract to the Bidder, meeting the specified qualifying requirement and also whose Bid has been determined to be substantially responsive to the Bid Documents and who has offered the lowest bid price in pursuance to the bidding conditions.
9. Interested bidders have to register themselves on the e-portal i.e., **https://etender.sjvn.co.in/SRMLogin/SRMLogin.jsp**. The details of registration process & fee, bidding process etc. are available under the e-Tendering & Reverse auction portal & bidder Manual also available on https://sjvnindia.com/UploadFiles/FileUploadManagement/SJVNeTenderingBidderManual.pdf under Tender Management system section (where the e-Tendering & Reverse auction portal is also available). The interested Bidders can download the Bid Document from websites: **www.sapdc.com.np, www.sjvn.nic.in & www.eprocure.gov.in.** Further, Amendments/Corrigendum /Notification (if any) shall be issued only on above mentioned websites.
10. The key particulars/details and dates of this invitation are as under :

Sr. No.	Description	Particulars
10.1	Cost of Tender Document	NPR 10,000/- (For Nepalese bidders) or INR 7,000 equivalent to NPR 11,200/- (For Indian bidders) in the form of Manager's cheque in favour of "**SAPDC-NPR CONSTRUCTION ACCOUNT"** Alternatively, payment against Cost of Tender Document may be made directly in the bank account of SAPDC as mentioned below: - NPR Account Details: Name of Bank: Everest Bank Limited, Nepal

		Name of beneficiary: **"SAPDC-NPR CONSTRUCTION ACCOUNT"** Acc. No. 00800105200477 Swift Code: EVBLNPKA ***Bidder shall be responsible to ensure the receipt of net amount (excluding bank transfer charges) in the account before last date of submission of bid. Further, the bidder shall submit the documentary evidence/ proof of same (swift statement/ transfer statement/ account statement) along with technical bid in Part-I (Envelope-I).**
10.2	EMD/ Bid Security (Clause 18.0 of ITB)	**EMD to be deposited in the manner and form prescribed under Clause No. 18.0 of ITB:** INR 1,53,35,000/- (Indian Rupees One Crore Fifty Three Lakh and Thirty Five Thousand only) OR NPR 2,45,36,000/- (Nepalese Rupees Two Crore Forty Five Lakh and Thirty Six Thousand only)
10.3	Last date for receiving request(s) for clarifications on bid documents from Bidders, if any, through email address pna.sapdc@gmail.com. Clarification on bid documents (**if required).**	10 days prior to last date of bid submission mentioned in Sr. No. 10.4 of NIT. The clarification meeting (**if required through video conferencing)** may also be held, for which separate notification shall be issued on websites www.sapdc.com.np, www.sjvn.nic.in & www.eprocure.gov.in
10.4	Deadline for submission of bid & place of submission. *(ref. clause 21,22 of Instruction to Bidders, Vol-1, Section-1 of Bid Documents)*	Online & Offline Submission: up to 10.03.2023 (1500 Hrs. IST) **O/o Chief Engineer (P&C), SAPDC, Satluj Bhawan, Tumlingtar, Distt. Sankhuwasabha, Nepal, Ph. +977-29-575154, 9852099789** **OR** **O/o Company Secretary, SJVN Arun- 3 Power Development Company (SAPDC), 3rd floor, Citizen Investment Trust (CIT) Building, New Baneshwor, Kathmandu, Nepal**. Contact No: +977 9819822967
10.5	Date & time for Bid opening	**Techno- Commercial Bid (Part--I):** Online & offline Bid opening on 13.03.2023 at 1600 Hrs. (IST) **Price Bid (Part--II):** Online bid Opening- shall be notified later on, separately on following websites: **www.sapdc.com.np, www.sjvn.nic.in/tender.htm, & www.eprocure.gov.in**

		(Only i.r.o. the bidders meeting the specified qualifying criteria and also whose Techno-Commercial Bids are found responsive).
10.7	Venue for opening of bid	**O/o Chief Engineer (P&C)** **SAPDC, Satluj Bhawan,** **Tumlingtar, Distt. Sankhuwasabha, Nepal**

11. For any enquiry with respect to project site, site visit etc. the Bidder may contact the following person :

Designation	Address	Phone No.
CGM (Civil Design Arun-3 & Lower Arun HEP), SAPDC	SAPDC, Arun-3 HEP, Satluj Bhawan, Arun Sadan, Tumlingtar, Distt. Sankhuwasabha, Nepal. E-mail: design.lahep@gmail.com	+977-9852099701

12. For any enquiry/clarification for submission of Bids and any other information, the Bidder may contact the following person:

Designation	Address	Phone No.
Chief Engineer (P&C)	SAPDC, Arun-3 HEP, Satluj Bhawan, Arun Sadan, Tumlingtar, Distt. Sankhuwasabha, Nepal. E-mail: pnc.sapdc@gmail.com	Ph: +977-29-575154 Mob.:+977-9852099789

13. All correspondence with regard to the above shall be made at the address indicated below.

14. For any enquiry/clarification for registration, e-tendering system linked with technical issue/support, the Bidder may contact the following person:

Name	Address	Phone No.
Mr. Digvijay Kamta	-	+91 9129989000
Mr. Sanjaya Bhatnagar	-	+91 9456119194

Chief Engineer (P&C),
SAPDC, Arun-3 HEP, Satluj Bhawan,
Arun Sadan, Tumlingtar,
Distt. Sankhuwasabha, Nepal
E-mail: pnc.sapdc@gmail.com
Ph. +977-29-575154, +977-9852099789

Information for Bidders (IFB)

PROJECT PROFILE AND SCOPE OF WORK

1.0 LOCATION

Arun-3 HEP is located on River Arun, which is one of the main tributaries of River SaptKosi near Num village of Sankhuwasabha District in Nepal. The Project has been contemplated as a run-of-river scheme which envisages about 70 m high concrete gravity dam, underground Power House and TRT Outfall Plunge pool area.

The project is located at Latitude 27°30'N to 27°35'N and Longitude 87°12'E to 87°20'E. Jogbani, Distt. Bihar, India is the nearest rail head to the project. All rail freight for Nepal has to be unloaded there. From Jogbani, the road distance to the project sites via Biratnagar, Nepal is about 300 km. The dam site is located at about 60km from Tumlingtar, where exists an airstrip connected to Kathmandu/Biratnagar by half an hour journey by air.

2.0 SCOPE OF WORKS

Generally, this contract comprises, but is not necessarily limited to works and responsibilities associated with the construction and performance by the contractor of the following principal features, all of which are described in details in the bidding documents but are summarized here in for convenience:

- Construction of Tail Race Pond 66.4 m (L) x29.25 (B) x 28m (H).
- Outfall Structure 76m long along with gated structure.
- Intake Structure 33.5m long (including 12.5m long transition) along with gated structure.
- 100m long 10.5 m finished dia, concrete lined Head Race Tunnel (from STA. 0.00 to STA. 100 m)All other works not specifically included but necessary to complete the works of Tail Race Pond, Outfall Structure, Intake Structure and 100m long 10.5 m finished dia, concrete lined Head Race Tunnel including but not limited to mining clearance/license, explosive license, construction power arrangements etc.

3.0 INFRASTRUCTURE WORKS

3.1 Temporary Roads:

The roads under this head shall comprise of the following roads:

(i) Access roads to shoal areas.

(ii) Access roads to contractor's facilities, labour camps, offices, residences, stores, workshops, batching &mixing plants, quality control laboratory etc., required by the contractor for successful completion of the works.

(iii) Any other additional road on the site as the contractor may consider necessary for work sites.

The contractor shall design, construct the above roads and maintain the same including sprinkling with water from time to time as directed by the Engineer at his own cost.

4.0 TRANSPORTATION AND COMMUNICATION FACILITIES

4.1 Transportation Facilities

The project lies in the Sankhuwasabha District of Province-1 of Nepal. The Tail Race Pond & outfall, Intake structure and 100m HRT are located at village Pukhuwa on left bank of Arun River, a principal tributary of Sapt Koshi, near power house of under constriction Arun 3 HEP. At present access to site of above works lies through Jogbani-Biratnagar- Hile-Tumlingtar-Khandbari-Chaunkutty-Pukhwa route. Jogbani to Khandbari is connected by all-weather metaled road. Jogbani is a city in the state of Bihar (India) with Nepal border and is just 7.60 Km. from Biratnagar (a major industrial town of Nepal). The nearest airstrip near the project area exists at Tumlingtar which is connected to Kathmandu by half an hour journey. Tumlingtar is also connected with Kathmandu by 680 km long road.

Road conditions in different road segment en-route are as under:-

i. Jogbani to Khandbari :- Khandbari is located at a distance of about 203 Km from Jogbani and the existing road up to Khandbari is black top road and in good condition.

ii. Khandbari to Chainkutty: The road from Khandbari to Chainkutty (Koshi Highway) is about 17 km long. The road is unmetalled road.

iii. Chainkutty to Work site: The road from Chainkutty to Project site is about 29 km leading to power house site of under construction Arun-3 HEP and Tail Race Pond & outfall, Intake structure site of Lower Arun HEP. The road from Chainkutty to Project Site is unmetalled road.

4.2 Communication facilities

At present, communication signal (Mobile/landline) is available at site. The site is connected with mobile, landline and internet connectivity.

5.0 HYDROLOGY

The Arun River is a tributary of the Saptakosi River running through the eastern part of Nepal and takes its rise from a glacier in the Tibetian highland north of the Himalayan range. As Lower Arun HEP will run in tandem with upstream Arun-3 HEP and water available at tail race of Arun-3 HEP shall be tapped in to water conductor system of Lower Arun HEP, the catchment up Arun-3 dam has been used for hydrological analysis. Catchment area at dam site of Arun-3 dam is 26747 sq km, about 95% (25307 Km^2) of the catchment area is situated in Tibet. Average annual rainfall over the catchment is 1921.9 mm.

Rainfall data of two stations viz. Num and Dingla near the project site is enclosed as **Annexure-2**.

Hydrological Data near the tail Race Pond & outfall, intake structure works is enclosed as **Annexure-3.** Maximum water level of El 539 has been considered at TRT outfall with deck level at El 545.00 m.

(The above data is being provided for planning purpose only and no claim whatsoever arising out of this shall be entertained).

6.0 TOPOGRAPHY& PHYSIOGRAPHY

Most of the Tibetan part of the Arun River basin is formed by highland above elevation 4500 m and is surrounded by high mountains, characterized by glacial or periglacial landforms. It covers an area of about 26747 km^2. The Nepalese drainage area up to the dam site of Arun-3 HEP dam site is about 1440 km^2. The average bed slope is about 0.8% in the upper catchment of Tibet, and increases drastically to 3-4% towards the Tibetan-Nepalese border, and in Nepal. The activities for Tail Race Pond & outfall, Intake structure works mainly lie in between EL 650 m to EL 500 m above mean sea level.

7.0 GEOLOGY

7.1 Geology of Tail Race Pond & Outfall and Intake area

Tail Race pond & outfall and intake structure are to be excavated in grey to grayish brown, medium to coarse grained, blocky to massive and strong Quartz-biotite-feldspar augen gneiss and granitic gneiss after removal of overburden. The rock is sparsely traversed by the joints and shear seams. The excavation is anticipated to witness moist to moderate water infiltration conditions. Overall rock mass conditions are anticipated to vary within fair-good-very good range except for a couple of reaches where poor rock zones are likely to be encountered due to clustering of joints/ shear planes. Deterioration of rock mass in such zones is further abated by dripping water conditions causing staining of joint/shear planes. The proposed portal area of intake structure consists of sound augen gneiss forming moderate to steep slopes along the Arun-3 Power House road. Moderate weathering effects extend to a lateral depth of 10-20m from the slope. Adequate rock cover is available and foliation planes dip into the hill with a low dip of 20° to 30° in the intake structure area. However, moderately to steeply dipping joints and shear planes, particularly the westerly dipping joints should be taken care during excavation of portal and also portal back slopes.

7.2 Geology of Head Race Tunnel (From STA. 0.00 m to 100 m)

It is found around the upper part of the area along the tunnel alignment, the rock is exposed at places on the surface and mostly covered with colluvium deposits over the hill slope. Initial 100m length of Head race tunnel alignment is passing through the low to high grade metamorphic rocks consisting of gneissic zone. The average dip direction of foliation varies from SE to NE and the dip angle varies from 20°-30° degrees in gneiss rock. But the rock is highly crushed and highly jointed in places where it is exposed too. The inlet portal of the tunnel is within the gneiss. The gneissic rock mainly consists of augen gneiss and granitic gneiss. Rock type along HRT alignment is Augen gneiss and granitic gneiss with thin bands of mica schist, shear seams, fractured zones. Very good to good conditions of rock mass is expected in this reach except few reaches where rock mass of fair condition may encounter. Dry to wet conditions with water seepage is expected during excavation at places.

The estimation about the Geological conditions to be encountered during execution as given above is merely a tentative which may differ on actual execution. Hence the contractor required to make his own assessment on the geological conditions.

7.3 Seismicity

The Lower Arun HEP site falls in the highly seismic Himalayan tectonic province, which has experienced several significant earthquakes in the past. The area of the project site is characterized by a complex system of transverse faults, intersecting through the longitudinal Himalayan system of faults. All the major tectonic features in the area are active, as evidenced by the association of epicentres of past earthquakes with them. As recommended by FE &SA, CWC, India after approval of Chairman National Committee on Seismic Design Parameters (NCSDP), India, the site specific horizontal and vertical seismic coefficients of Arun-3HEP shall be adopted for design of Lower Arun HEP. The site specific horizontal and vertical seismic coefficients of Arun-3 HEP approved by NCSDP are horizontal Seismic coefficient αh=0.24 and vertical seismic coefficient αv=0.16 and same has been adopted for Lower Arun HEP.

7.4 Laboratory and In-situ Test Results

Various laboratory and in-situ test results were carried out for Tail Race Pond & outfall, Intake structure area and results are summarized below:

Test Results

Sr. No	Description	Test Values
1	**UCS**	
	Gneiss	32.33 to 48.53 MPa (avg=40.19MPa)
2	Tensile strength	Between 2.6 to 10.71 MPa (avg=5.895MPa)
3	Internal Friction Angle ,Φ	39.55^0
4	Cohesion ,c	9.17 MPa

8.0 *Deleted without change in Sr. No.*

9.0 POWER EVACUATION ASPECTS:

The power from Lower Arun HEP shall be evacuated by D/C LILO of under construction 400kV Quad Moose line between Arun-3 HEP and 400/220kV Dhalkebar substation.

10.0 ENVIRONMENT ASPECTS

Nepal has developed an extensive set of legislation for regulating the environmental and social aspects for developmental projects. Nepal's laws and relevant legislation on environment conservation and social aspects includes major provisions for Nepal Environmental Policy and Action Plan, 2076 (2019);, Soil and Watershed Conservation Act, 2039 (1982); Forest Policy, 2075 (2019);, Forest Act, 2076 (2019); Forest Rules, 2079 (2022);, Forest Produce Collection and Sales Distribution Guidelines, 2071 (2015); The Aquatic Animal Protection Act, 2017 (1960); National Parks and Wildlife Conservation Act, 2029 (1973); , Explosive Material Act, 2018 (1961); Land Acquisition Act, 2034, (1977); Guthi Corporation Act, 2033 (1976); and Land Reform Act 2020 (1964)

Environment Protection Act, 2076 (2019); Water Resources Act, 2049 (1993); Solid Waste Management Act, 2068 (2011); International Trade in Endangered Species of Wild Fauna and Flora Act, 2073 (2017); Land Use Act, 2076 (2019); Environment Protection Rules, 2077 (2020); Solid Waste Management Rule, 2070 (2013); National

Ambient Air Quality Standards, 2069 (2012); National Noise Level Standards, 2069 (2012)

11.0 DETAILS OF QUARRIES

Sr. No.	Quarry/Borrow Area	Capacity (Cum Approx.)	Location	Distance from working area
1	Nekhuwakhola	376000	At RD 23 km of Chainkutty-Diding road	Approx. 5.5 Km from working site.
2	Power House Colony right bank	376000	Lies on the Right bank of Arun river and near to Power House, Arun-3 HEP	Approx. 2.65 Km from working site.
3	Boulder from River bed of river Arun	-	Left bank of River Arun near Power House Arun-3 HEP	Approx. 300 m from working site

The quarry at right bank of river Arun near to power house site can be accessed through power house bridge after completion of same, as such the Contractor claim shall not be admissible for any cost compensation on account of non-availability of said bridge.

12.0 DUMPING AREA

Sr. No.	Dumping Area	Capacity (Cum)(Approx.)	Location	Distance from working area
1	Dumping site surge shaft camp area of Arun-3 HEP	50% of excavated Qty.	Surge Shaft Top of Arun-3 HEP.	Approx. 6.15 Km from working site.
2	Power House Arun-3 HEP	50% of excavated Qty.	Near power House of Arun-3 HEP.	Approx. 0.5 Km from working site.

13.0 OTHERS / MISCELLANIOUS

i) **General Climatic Condition in the Project Area:** The climate of the area is monsoonal in nature, as about 70% of the annual precipitation is received in the months from June to September. Since, Arun river basin lies within Eastern Himalayan region, where the monsoon has a more extended regime, rainfall is received throughout the year.

ii) **Port Facilities**: Nearest port at Kolkata, India (about 600km from Jogbani).

iii) **Availability of Land to the Contractor:** Land for Infrastructure shall be arranged by the Contractor himself at his own cost except for that specified elsewhere in the Contract to be made available by Employer. Accordingly, the Contractor shall be responsible for arranging land for his installation facilities/job facilities viz. labour camp, batching plant, crushing plant, infrastructural facilities etc. for use by the Contractor, as above.

The Employer shall arrange land for Permanent Works, dumping area and quarries, free of cost to the Contractor.

The use or occupation of the land by the Contractor shall not confer on him any right of tenancy or possession thereof. The Contractor shall vacate immediately land upon one month notice of the Engineer.

iv) **Drinking Water Arrangement:** Natural sources available.

v) **Medical facilities: District** HQ of Sankhuwasabha at Khandbari

vi) **School: Dadagaon** (PH site) and District HQ of Sankhuwasabha at Khandbari

vii) **Bank: District** HQ of Sankhuwasabha at Khandbari

viii) **Inner line permit / pass required for contractors and his workmen:** As per Law of Land

ix) **Availability of nearest fuel station: Tumlingtar** and District HQ of Sankhuwasabha at Khandbari

x) **Manpower: Population** is very thin. Total population of District Sankuwasabha is approx. 1,50,000 (Census 2011 of Nepal)

xi) **Explosive Magazine:**

The Contractor shall arrange explosives and their license(s) for all requirements of explosive required for the completion of works at his own cost.

The contractor shall also construct explosive magazine at his own cost as per design approved by Nepal Army/ Employer.

The contractor shall also construct residential accommodation/ barrack for Army Security personnel at his own cost as per design/drawing by Nepal Army / Employer.

The contractor shall procure explosives either from Nepal Army or import the same from India. The Contractor shall comply with all relevant laws, ordinances, instructions, regulations issued by Government from time to time regarding the purchase, import, handling, transportation, storage, safety, security, use and management of Explosives.

Further, as per norms of GoN, the security arrangements for explosives during transportation within Nepal, storage and use etc. shall be provided by Nepal Army & any type of cost which is incurred during transportation, storage and uses of explosive shall be borne by the contractor.

The cost for Explosive arrangement includes any expenditure incurred either to comply with all relevant laws, ordinances, instructions, regulations issued by Government from time to time regarding the purchase, import, handling, transportation, storage, safety, security, use and management of Explosives or due to any MOU/agreement signed between Employer, Contractor & Nepal Army for explosive management.

The contractor shall also be responsible for housekeeping of the residential accommodation/barracks and shall make necessary arrangements for boarding, lodging, kitchen utensils, arrangement of electricity etc. and transportation of army personnel, APF, Nepal Police in line with any MOU/agreement signed between Employer, Contractor & Nepal Army at his own cost.

The bid prices shall be deemed to be inclusive of all costs regarding procurement, usage, transportation and all the other expenses associated with handling of explosives like coordination with local administration, Nepal Army, APF, Nepal Police etc.

14.0 CONSTRUCTION PERIOD OF THE PACKAGE: 9 months

15.0 SALIENT FEATURES:

LOCATION	
Country	Nepal
District	Sankhuwasabha
Vicinity	All components of project are on Left bank of River Arun. The Intake Works are at village Pukhwa and Power House at village Beteni about 10 Km upstream of Tumlingtar.
HYDROLOGY	
Design Flood at Lower Arun PH Site	
10,000 Year	10134 m^3/s
Highest Flood Level	315.10 m
Design Discharge	344.68 m^3/s ***(Only the tail waters of Arun-3 HE Project will be utilized)***
TAIL RACE OUTFALL POND (To be constructed as a part of Arun-3 HEP)	
Null Level	537.00 m
Maximum water level	544.00 m
Top elevation of structure	545.00 m (Corresponding to Design flood of 15710 m^3/s at TRT Outfall in Arun-3 and Maximum water level in pond during Tandem Operation)
INTAKE STRUCTURE (To be constructed as a part of Arun-3 HEP)	
No. of intake	1 No.

Intake Gates	2 Nos. 6.00 m wide x 7.00 m high
Length of HRT to be constructed with intake	100 m
SPILL TUNNEL CUM CONSTRUCTION ADIT-1	
Type	Horse shoe, concrete lined
Taking off at	STA 300.00 m of HRT
Size	10.5 m dia
Length	327.689 m up to centerline of HRT
Spill tunnel invert level at exit	537.00 m
Spill Tunnel Gate	1 No 10.5 m wide X10.5 m high
HEAD RACE TUNNEL	
Type	Horse Shoe, concrete lined
Size (finished diameter)	10.50 m
Length	17.4 km
Velocity	3.77 m/s
No. of Adits	6 Nos. (Incl. Spill Tunnel Cum Adit-1)
Access Gate at the Plug of Adit-3	1 No 2.50m wide X 2.50 m high
SURGE SHAFT	
Numbers	One
Type	Restricted Orifice, open to sky
Diameter	33.84 m
Depth	134.75 m from centerline of HRT
Gate size	5.85m (W)(x5.85 (H) m, 2 nos.
Elevation of center line of head race tunnel	445.25 m
Elevation of invert of surge shaft	452.5 m
Maximum upsurge	569.95 m
Minimum down surge	502.70 m
BUTTERFLY VALVE HOUSE	

Type	Underground
Size of valve house	91 m long x12m wide x 21 m high
No. of butterfly valves	2 Nos.
Size of valves	5.5 m internal dia.
TAIL RACE CHANNEL	
Type	Rectangular concrete lined and cast in-situ concrete blocks
Size	50 m wide
Length of tail race channel (including transition)	72.93 m
Crest elevation	EL 305.355 m
Normal tail water level for power generation (Q = 344.68 cumec)	EL 307.04 m
Minimum tail water level (Q = 8.617cumec 10% of one unit Discharge)	EL 305.50 m
Maximum tail water level (10% overload)	EL 307.158 m
SWITCHYARD	
Type	Surface 400 kV Switch Gear GIS type with double bus bars arrangement

Monthly Rainfall Data of Num Gauging Station For the period 1959-2007

Rainfall in mm													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Total**
1959	0	0	0	0	0	675.6	789.8	296.9	279.8	62.2	3.5	0	2107.8
1960	0	27	75.5	113.2	508.2	1089.7	912.2	1399.9	1515.1	561.7	55.9	12.5	6270.9
1961	198.2	25.7	163.7	127	540.4	609.4	671.9	584.5	653.8	279.9	67	85	4006.5
1962	110.8	175.5	210.5	119.6	332.5	731.6	318	498.1	58	128.2	48.8	5.9	2737.5
1963	0	3.5	28.4	96.5	93.9	146.1	208.1	349.2	139	91.2	41.1	29.3	1226.3
1964	0	0	0	212	233.8	403.3	721.3	690.7	352.3	406.8	102.5	54.7	3177.4
1965	98.5	61.2	48.2	264.2	442.8	547.3	661.6	639	792.8	86.4	156.4	51.1	3849.5
1966	81.6	16.1	0	85.4	427	985.8	734.1	908.8	745.5	231.5	28.4	0	4244.2
1967	0	0	210.8	131.7	577.3	681.4	466.3	593.4	505.6	189	221.3	84.6	3661.4
1968	39	15.3	103.3	85.8	624	614.9	897.2	633.4	931.4	311	96	0	4351.3
1969	0	0	120	150.4	179.8	526.7	573.4	232.5	71.1	4.3	14.8	11.6	1884.6
1970	78.2	10.8	163	113	78.2	196.3	144.2	185.5	366.7	109.3	0	0	1445.2
1971	0	21.4	158.4	700.3	559.6	651.3	313.2	297.2	45.4	29.7	11.2	0	2787.7
1972	0	1.3	9.1	254.5	698.4	648.2	457.5	144.6	118.1	143.1	106	23.6	2604.4
1973	0	124.1	53	90.9	579.9	1016.9	515.7	574.3	462	120.2	37.7	9	3583.7
1974	0	10.4	94.8	492.2	904.4	995.6	792.1	777.3	436.5	680	0	43.4	5226.7
1975	42.2	96.7	12.4	135.8	471.5	938.7	722.9	617	820.4	545.7	0	16	4419.3
1976	26.4	71.6	39.4	81.2	742.7	1401	908.7	549.8	345.2	356.4	70.4	4	4596.8
1977	0	110.2	79	732.2	561.9	738.2	1081	1039.3	397.1	362	200.9	30.7	5332.5
1978	5	0	73.1	232.9	548.6	1019.1	722.5	811.3	580.7	80.9	150.5	0	4224.6
1979	0	42.5	0	366.1	636.1	566.9	966.1	618.5	1044.1	1462.5	39	46.5	5788.3
1980	0	87.3	183.7	201.7	618	893.2	1054.3	815.5	883.2	170.9	0	0	4907.8
1981	72	0	61.2	403.7	301.3	580.8	848.2	770.5	598.7	0	30.5	0	3666.9
1982	0	102	79.5	218.4	431.7	903.7	743	113	117.1	101	78.3	13.5	2901.2
1983	22.5	41.5	31	185.5	289	915.4	696	409.5	470.6	0	0	6.5	3067.5
1984	15.5	0	93.8	114.4	574.3	582.2	959	440	388	25	16	0	3208.2
1985	15	0	200.5	170.5	577	1302.5	728.3	864.5	407	209	16	81.5	4571.8
1986	9	31.2	54.7	333.5	430.4	769.4	793.4	678.7	554.5	155.1	0	0	3809.9
1987	0	64	153	402	387.4	734	958.5	478	608	70	0	23	3877.9
1988	0	29	116	208	383	517.6	711	1049.5	574.8	78.3	5	3	3675.2

1989	62	61	121	88	262	606.3	677	688	557	196	47	29	3394.3
1990	26.6	174.6	317	97.5	215	1038.6	1339.9	871.6	728	239.7	0	0	5048.5
1991	78.2	38.3	92.7	193.2	759.3	1197.6	1280.4	995.7	663.4	75.7	41.8	32	5448.3
1992	27.2	98.7	25.5	65.2	708.7	842.4	922.1	742.8	706.8	467.9	13.9	14	4635.2
1993	22.2	149.3	50.2	295.5	285.2	575.6	1246.4	977.5	658.1	340.7	5.5	19.5	4625.7
1994	19	18.2	202.8	176	613	1207.9	1533	796.1	401.5	96.9	45.1	5.3	5114.8
1995	0	43.9	55.4	244	807.3	1095.5	712.1	738.5	383	147.9	173.5	153.2	4554.3
1996	137.1	85.3	209	128	995.2	938.2	1188.5	692.6	760.4	137.7	3.2	0.1	5275.3
1997	59.7	211.5	66.4	368.8	474	1695.5	554.5	580.7	703.2	112.9	35.7	32.7	4895.6
1998	25	113	117.7	212.4	372.1	1246.4	1053.3	1186.6	553.6	206.6	32.7	0	5119.4
1999	21	10.5	12.2	404.5	1060.8	531.4	986	596.1	417.3	361	20.5	0	4421.3
2000	0	8.2	6	347.4	632	741.3	1220.7	789.5	458.2	173.6	69	0	4445.9
2001	0	0	93.5	565	925.4	1085.7	374	754.6	568.7	340	70	0	4776.9
2002	55	10.4	86.2	183	461.8	690.7	886.5	718.2	636.5	68.2	0	0	3796.5
2003	22.5	158	278.3	632.4	118.1	519.6	944.4	605.5	804.3	52.5	4	12	4151.6
2004	45	54.5	101.4	706	511.3	798.5	792.5	831.3	824.4	189.6	17.7	10	4882.2
2005	72.5	33.7	91.3	267.2	658.1	676.8	631.7	692.2	612.3	237.4	7.9	10.1	3991.2
2006	0	13.1	82.9	239.5	545.4	1170.9	846.4	706.5	490.5	427.5	48.2	12.5	4583.4
2007	0	275.3	97.5	191.5	453	1271.9	551.3	536.8	766.4	99.5	20	0	4263.2
Monthly Average	**30.34**	**55.63**	**96.39**	**249.54**	**501.85**	**822.73**	**792.04**	**664.51**	**550.12**	**224.95**	**45.98**	**19.71**	**4053.81**

Monthly Rainfall Data of Digla Gauging Station For the period 1950-2007

Rainfall in mm													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual Total**
1950	0	0	0	0	0	15.2	181.6	0	0	0	0	0	196.8
1957	90.2	14.1	17.3	23.8	72.9	276	467.4	442.1	429	106.7	0	18.3	1957.8
1958	32.3	0	6.3	49.4	104.4	149.6	352.6	660.9	275.5	89.9	0	7.6	1728.5
1959	43.2	11.4	26.7	129	190	262	315	894.2	705.9	293.1	0	0	2870.5
1960	0	8.4	64.4	23.6	191.4	200.8	257.5	317.5	319.7	75.5	0	0	1458.8
1961	0	26.5	12.9	22	194.3	290.2	331.9	510.4	294.2	73.2	0	0	1755.6
1962	25.5	61.6	30.8	40.5	164.7	465.6	267.6	514	225.4	30.5	0	0	1826.2
1963	14	0	24.8	35.2	102.1	364	377.8	470.9	179.1	101.1	38.5	0	1707.5
1964	0	0	0	114.2	91.4	198.6	658.1	249.8	426.3	82.2	0	0	1820.6
1965	0	40.8	55.1	35.2	158.4	372.3	325.7	478.5	296.4	87.2	31.2	0	1880.8
1966	39	0	0	36.9	87.2	156.9	335.8	480.2	294.6	32.2	0	9.9	1472.7
1967	0	0	64.3	76	96.2	156.1	346.2	264.2	286.9	26	9.6	0	1325.5
1968	6.1	0	8.9	9.4	158.6	260.2	323	332.2	603.7	255.8	0	0	1957.9
1969	0	0	39.9	18.3	123.4	61.3	330.8	293.9	188.9	44.5	0	0	1101
1970	5.4	39.7	10.4	74.5	9.4	408.8	610.9	213.2	385.2	35	14.2	0	1806.7
1971	0	0	34.7	98	213.4	390.1	298.4	369	324	140.4	34	0	1902
1972	6	6.7	51	285	322.5	223.7	242.9	120.5	267.4	68.6	18.2	0	1612.5
1973	0	18.4	37	62.2	253.7	425.5	369.4	396.8	258.9	202.7	12.4	0	2037
1974	17.6	0	30.3	171.6	172.8	442	554.6	716.6	209.3	219	0	6	2539.8
1975	19.1	29.5	0	41	176.7	347.6	513.4	151.1	583.4	123.8	0	2.4	1988
1976	29.6	7.2	0	65.7	254.1	380.2	488.5	332.5	58.3	2.1	0	0	1618.2
1977	0	0	43.6	86.5	170.4	160.4	386.6	476.3	330.3	18.8	28	47.9	1748.8
1978	6.9	2.1	73.6	79	243	308.1	467.6	303.6	316.8	73.5	11.5	9.6	1895.3
1979	0	26.2	0	108.2	154.8	487.4	338.1	438.1	433.3	149.4	13.5	55.6	2204.6
1980	0	7.1	50.3	47.6	229.1	223.6	265.6	330.8	497	124	19	0	1794.1

1981	30.1	0	50.2	88.8	263.9	254.8	550.4	455.1	273	27.3	13.9	0	2007.5
1982	0	20.3	25.4	104	113.7	474.2	302	188.3	313.4	138	44.9	0	1724.2
1983	17	4.8	21.9	74.5	234.7	309.2	603.1	292.1	358	62	0	16.6	1993.9
1984	13.6	7	3.5	138.1	329.7	274.8	492.7	273.3	333.6	60	6.7	0	1933
1985	7	32.8	49.6	89.4	264.6	153.4	662.8	310.9	353.5	137.2	21	32.5	2114.7
1986	0	12	24.3	71.6	91.5	206.4	370.1	405.1	308.1	63	30.3	14	1596.4
1987	9	13.3	78.4	130.1	124.9	334	367.7	339.3	562.1	248.6	3.5	8.5	2219.4
1988	0	47.7	76.4	73.2	196.3	183.5	386.5	992.8	499.8	26.8	0	80	2563
1989	37.6	6	100.2	0	327.3	371.2	618.7	424.8	470.2	126	3	5.3	2490.3
1990	0	84	57.6	80.7	303.1	312.4	293.5	539.1	308.9	22.7	0	0	2002
1991	42.6	2	51.2	55	171.2	685.4	334.1	457.3	395.4	25	0	11.2	2230.4
1992	10	0	0	15.6	154	121.8	664.1	126.3	151.9	125.4	1	16	1386.1
1993	19	11.6	35.6	118.9	195.9	174.3	302.6	528.2	267.9	155.1	40	0	1849.1
1994	61.4	38	57.2	39.8	167.7	261.2	326	455.7	275.9	2.3	17.7	5	1707.9
1995	5	20.5	18	80.2	175.7	580.5	495.5	264.4	228.1	141.5	120	40	2169.4
1996	44	0	44.5	57.5	151.8	314.3	565.3	311.1	464	58	0	0	2010.5
1997	28	14	13	78.2	160.3	167.7	319.6	532	498.2	66.2	0	45.5	1922.7
1998	0	15.5	87.8	156.8	165.9	264.1	472	743.5	308.5	204.6	13	0	2431.7
1999	9	0	0	2	436.5	288.3	656.4	457.2	230.3	160	16.5	0	2256.2
2000	6.5	11.5	6	112.5	265.5	270.3	398.4	370.1	212.4	90.4	14	0	1757.6
2001	0	108.3	24	127.6	168.4	288.2	406.2	543.4	434.4	80.4	0	0	2180.9
2002	7	4.4	38	172.4	173.3	303.4	468.3	286	186.3	36.7	0	0	1675.8
2003	26.9	40.6	86.6	89.7	68	595.1	406.2	182.7	425.3	80.2	0	24	2025.3
2004	11.4	3	30.6	160.7	168.8	301.4	396.8	285.6	412.3	62.5	0	0	1833.1
2005	29.4	0	30.4	122.5	122.8	259.3	372.8	240.4	175.3	43.1	0	0	1396
2006	0	0	35.6	70.8	124.4	359.1	98.6	219.7	156	40	0	9	1113.2
2007	0	78.2	34.6	113.8	240.6	324.9	458.2	293.3	651.1	172.6	5.4	4	2376.7
Monthly Average	14.41	16.83	33.90	79.95	178.76	297.30	407.61	389.90	335.45	94.44	11.17	9.02	**1868.734615**

Annexure-3

Hydrological Data near power house complex (2008-2012)

Discharge Data at Powerhouse site (Maximum values derived from daily flows)													
Year	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Max.**
2008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	158.13	141.01	**158.13**
2009	86.64	72.51	86.10	166.96	599.28	753.03	883.12	884.86	526.29	440.06	143.42	144.22	**884.86**
2010	60.17	57.03	141.25	164.77	312.40	712.47	841.88	1158.96	952.24	470.19	196.12	132.95	**1158.96**
2011	116.88	148.89	164.86	194.37	394.04	638.30	1353.35	1261.76	865.03	584.89	423.75	151.27	**1353.35**
2012	123.04	139.75	159.41	184.07	392.18	601.01	0.00	0.00	0.00	0.00	0.00	0.00	**601.01**

Press Notice, NIT and Information for Bidders (IFB)

Volume-0, Section-0

INSTRUCTIONS TO BIDDERS & BID DATA

TABLE OF CONTENTS

A. GENERAL

1. SCOPE OF BID

1.1 SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC), is a company promoted by SJVN Ltd., as a single shareholder company in Nepal having its office at Satluj Bhawan, Arun Sadan, Tumlingtar, Nepal (here-in-after referred to as "Employer").

1.2 *Deleted without change in Sr. No*.

1.3 SAPDC hereby invites Item Rate bids in single stage two envelope bid system from the competent Bidders/Contractors for construction of Works, as described in this Bid Document and summarized in the Bid Data, here-in-after referred to as the "Works". The bids shall be submitted as per provisions laid under Clause 21 of ITB.

1.4 The successful bidder will be required to complete the 'Works' within the period stated in the 'Bid Data' and 'Appendix to Tender' effective from the date of issue of the "Letter of Acceptance" of the Works.

1.5 Throughout these Bid Documents, the terms bid and tender and their derivatives (bidder/tenderer, bid/tender, bidding/tendering etc.) are synonymous, day means calendar day. Singular also means plural, unless these are repugnant to the context.

2. SOURCE OF FUNDS

2.1 The Employer shall implement 4x225 MW Arun-3 Hydroelectric Project. The Project envisages a debt-equity ratio of 70:30.

3. ELIGIBLE BIDDERS

3.1 This invitation to bid is open to (i) all the bidders from India Or (ii) Joint Venture/Consortium of Indian firms Or (iii) Joint Venture/Consortium of Indian and Nepalese firms (Indian bidder as lead partner) provided they meet the Qualification Criteria as per Clause-5 hereunder.

3.2 Bidders should not have been banned/ de-listed/ black listed/ debarred from business by Government of Nepal or any of its Government Department during last 03 (three) years on grounds of corrupt/fraudulent practices and/or due to non-performance and/or by Ministry of Power, Government of India/SJVN/SAPDC on any grounds.

4. ELIGIBLE MATERIALS, PLANT, SUPPLIES, EQUIPMENT AND SERVICES

4.1 The materials, Plant or Contractor's Equipment (Equipment), other supplies, and services to be provided under the contract, shall have their origin in eligible source countries, defined under the Government of Nepal Guidelines, and all expenditures

made under the contract will be limited to such materials, Plant or Contractor's Equipment, other supplies, and services.

4.2 For purposes of Sub-clause 4.1 above, origin means the place where the materials, Plant, Equipment, and other supplies are mined, grown, produced, or manufactured, and from which the services are supplied.

5. QUALIFICATION OF THE BIDDER

5.1 Bidders shall, as part of their bid:

a) submit a written Power of Attorney (POA) authorizing the signatory of the bid to commit the bidder;

i) In case of a General Power of Attorney, a true copy of the POA shall be duly notarized by Notary Public along with a declaration from the Company Secretary/Corporate Secretary endorsing the validity of the Power of Attorney.

ii) In case of a specific Power of Attorney (as per format included in forms & procedures), the original POA along with a copy of the resolution of Board of Directors for the specific appointment. In case of delegation by a General POA holder, the documents as sought under i) above shall be submitted along with the original specific POA.

iii) Power of Attorneys executed by Bidders shall be duly stamped in accordance with applicable law in Nepal.

b) Submit/include in their bids the following information/documents:

(i) Evidence of access to lines of credit and availability of other financial resources;
(ii) Financial predictions for the current year and two following years, including the effect of known commitments;
(iii) Work commitments; and
(iv) Availability of major Equipment.

c) Each bidder shall duly fill in the prescribed Data sheets/ qualification particulars along-with relevant experience certificates, Annual reports and other information evidencing proof of their meeting the qualification criteria stipulated herein.

d) Submit an offer which is clear, comprehensive, unambiguous and complete in all respects including all necessary technical, contractual and commercial information.

e) Submit a declaration, as per Performa given in Section-4; Vol. 2 confirming that the bid submitted by the bidder is strictly in conformity with the documents issued by the Employer.

5.2 Bid submitted by a joint venture/consortium of not more than two (2) firms/companies, as partners shall comply with the following requirements:

a) The bid shall include all the information listed in Sub-Clause 5.1 above;

b) E-procurement portal permits only one person having Digital Signature Certificate (DSC) and registration etc. at the portal. In such a case, the lead partner shall register itself with the portal. The legally authorized signatory having notarized Power of Attorney of the partners of Joint Venture shall authorize lead partner to carry out bidding process through portal. An undertaking that the bidding process carried out by the person authorized by the lead partner at the portal is deemed to have been carried out by all the partners and the bid submitted online is binding on them is to be submitted in hard copy as per clause 21.6 of ITB. In case of a successful bid, the Agreement, shall be signed by all the partners so as to be legally binding on all partners;

c) One of the partners shall be authorized as the lead partner, who shall receive instructions and incur liabilities for and on behalf of the joint venture/consortium during pre-award and post-award (if awarded).

d) All discussions, bid clarifications and negotiations, if any, during pre-award stages shall be done with the lead partner along with other partners;

e) The payments against the Contract shall be made to the joint venture/ consortium;

f) All partners of the joint venture/consortium shall be liable jointly and severally for the execution of the Contract in accordance with the contractual terms, and a statement to this effect shall be included in the bid and in the Agreement (in case of a successful bid).

5.3 Bids submitted by a Bidder with sub-contractor(s), shall comply with the following minimum requirements:

(i) The Bidder and his sub-contractor(s) should submit separate undertakings (as per **Attachment-6(i)**) that the Bidder/sub-contractors shall be responsible for execution of that item of work for which they claim to have specific construction experience.

(ii) In order to ensure serious participation of the sub-contractor(s) for work proposed to be executed by the sub-contractor(s), a Joint Deed of Undertaking (as per **Attachment-6(ii)**) shall be required to be submitted by the Contractor and sub-contractor(s). Besides this, Sub-contractor(s) shall submit an additional Performance Bank Guarantee equivalent to 3% of corresponding value of work sublet in addition to Performance Bank Guarantee for whole Contract submitted the bidder on award of work.

5.4 Bids by Merged/Acquired/Subsidiary Company shall comply with the following minimum requirements:

(i) Commitment by the parent/holding company to sign a separ**ate agreement wi**th the Employer (as per format contained in **Attachment-7(i)**) confirming full support for the technical and financial requirements of the subsidiary company and commit to take up the work itself in case of non-performance by the subsidiary company in the event of award of the work to the subsidiary company.

(ii) Parent/holding company shall submit an undertaking alongwith the bid (as per format contained in **Attachment-7(i)**) that in case Bidding Company (Subsidiary Company) gets qualified and awarded the work package on **the strength of** Parent/holding Company, Parent/holding company shall furnish an additional performance bank guarantee of value equivalent to 3% (three percent) of the Accepted Contract Amount or the portion of work (where the subsidiary company is Joint Venture Partner) as the case may be, in addition to normal Performance Bank Guarantee to be submitted by the Bidder to the Employer besides entering into a separate Agreement (as per **Attachment-7(ii) or 7(iii), as applicable**).

5.5 The minimum qualifying requirement for the eligible bidders is as under:

5.5.1 Technical Criteria

5.5.1.1 General Construction Experience

The Bidder as Sole Contractor or Partner of a Joint Venture/Consortium or Sub-Contractor approved by the respective employer, should have experience of executing (includes completed and ongoing projects) a Works Contract of value at least INR 72 Crore in the preceding 15 years.

5.5.1.2 Specific Criteria

(a) Experience of executing (includes completed and ongoing projects) at least one civil work involving excavation / earth work of 1,03,000 m^3 or more in a single contract in last 20 years.

(b) Experience of achieving progress rate of execution of at least 1,03,000 m^3 excavation / earth work for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years.

(c) Experience of executing (includes completed and ongoing projects) at least one civil work involving concrete quantities of 30,900 m^3 or more in a single contract in last 20 years.

(d) Experience of achieving progress rate of execution of at least 30,900 m^3 of concrete quantities for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years.

5.1.1.3 Technical Experience

The Bidder as Sole Contractor or as Partner of JV or Sub-contractor approved by the Project Developer, should have executed following works in an ongoing/ completed

project during the preceding 20 years. The end date of completion of work should fall within the preceding 20 years reckoned from the last day of the month previous to the one in which NIT is invited.

i) Completion of tunnel of minimum 50 m length and 8m finished dia. with Drill and Blast Method. Completion of tunnel means completion of excavation and lining of at least 50 m length and 8m finished dia. Tunnel

ii) Open/underground excavation having quantity 1,03,000 m^3 in any single Hydro Electric project.

Notes for clause no. 5.5.1:

i. Experience of above different activities / sub-activities / components need not to be from the same project.

ii. Concrete quantity shall include shotcrete quantity also.

iii. Experience of self or JV/ Consortium partner or parent company will be admissible. For JV/Consortium provision of relevant clause of contract shall apply.

iv. In case of ongoing projects, the value of completed work done shall be considered for the purpose of qualifying criteria.

v. The period of 15/20 years as above shall be reckoned from the date of issue of NIT. If the work for which experience is being claimed has been completed in last 15/20 years period, even if it has started earlier, the same shall be considered.

vi. Experience certificate from employer and Work Order/Contract Agreement indicating the scope of work should be submitted alongwith the bid to substantiate the experience in all cases.

5.5.2 Financial Criteria:

i) Submission of audited balance sheets or if not required by the law of the Applicant's country, other financial statements acceptable to the Employer, for the last three years to demonstrate:

(a) The net worth shall be positive in two years out of the last three immediately preceding financial years. However, the Net Worth of the immediately preceding financial year shall be positive. The Net worth shall be calculated based on paid up Share Capital plus Securities Premium Account plus all reserves created out of the profits plus Unallocated Balance/ Surplus amount of Profit and Loss Account, less (a) deferred Expenditure and Miscellaneous Expenditure not written off, (b) Accumulated losses in Profit and Loss Account, if not reduced from reserves and surplus. The reserves created out of revaluation of assets, write-back of depreciation and amalgamation will not be included while calculating Net Worth, and

(b) Capacity to have a Cash Flow Amount/Working Capital of at INR 32 Crore or equivalent as evident from the immediate preceding financial year as per the audited Balance Sheet / equivalent Financial Statements. Working Capital/Cash Flow amount shall be submitted as a difference of Current Assets and Current

Liabilities, duly certified by Statutory Auditor/ a practicing Chartered Accountant.

Notes:

a. Banking reference should contain in clear terms the amount that the Bank will be in a position to lend for this work to the applicant / member of the Joint Venture. In case the Net Working Capital (as seen from the Balance sheet) is negative, only the Banking reference(s) will be considered, otherwise the aggregate of the Net Working Capital and submitted Banking reference(s) will be considered for working out the Working Capital.
b. The Banking reference(s) should be from a "A" Class Nepalese Bank/Scheduled Bank of India and it should not be more than 3 months old as on the date of submission of applications.
c. In case the applicant is a Joint Venture and if Banking reference is issued by the Bank in favor of the Joint Venture for this contract, then it will be considered for the applicants and if Banking reference is issued in favor of any member of Joint Venture, it will be considered only for that member.
d. In case of JV- requirement of working capital/net cash flow is to be distributed between members as per their percentage participation and every member should satisfy the minimum requirement for his portion.

ii) **Average Annual Construction Turnover:** Minimum Average Annual Construction Turnover shall be INR 72 Crore or equivalent for the immediate preceding two consecutive financial years.

General Notes for clause 5.5.2:

i. Sub-Contractor's financial parameters shall not be considered for working out Net Worth, Average Annual Construction Turnover and Working Capital of the Bidder.

ii. Construction Turnover duly certified by Statuary Auditor/ a practicing Chartered Accountant of the bidder/partner shall only be taken into consideration for evaluation purpose.

iii. Turnover of the applicant/partner from the related business i.e., Construction Turnover shall only be taken into consideration for purpose of evaluation. In case Construction Turnover is not shown separately in the financial statements, a certificate from Chartered Accountant certifying Turnover from Construction shall be submitted.

iv. Annual Report comprising audited Balance Sheets, Profit & Loss Accounts, the schedules and other Financial Statements of the immediate preceding three (3) years should be furnished by the bidder for evaluating the requirement stipulated hereinabove.

v. Immediate preceding financial year shall be the financial year ending six months before the last date of submission of Bids. For example, if the last date for submission of bids is between 1st April 2022 to 30th September, 2022, then the immediate preceding financial year shall be 2021-22 in case the Board has not approved the annual accounts for year 2021-22. In this case a statement to the effect that Board has not approved the Annual Accounts for the FY 2021-22 must be included in the requisite Statutory Auditor / CA Certificate(s).

In case board has approved the annual accounts for financial year 2021-22, then bidder has to submit such account and the year 2021-22 shall be taken as immediate preceding financial year. Similarly, where the last date for submission of bids is between 1st October, 2022 to 31st March, 2023, then the immediate preceding financial year shall be 2021-22.

vi. In case where Audited financial results for the immediately preceding year are not available, then a statement of account as on the closing date of the immediately preceding financial year depicting the Turnover, working capital and Net Worth (calculated as per laid down criteria) duly certified by their Statutory Auditor/ Certified Public Accountant carrying out the statutory audit shall be enclosed with the Bid along with copy of appointment letter of the Statutory Auditor.

vii. Wherever, the Annual Report/ duly notarized copies of Audited Printed Annual Financial Statement are in language other than English, then copy duly translated & printed in English language and certified by approved/ recognized English translator shall be submitted with the Bid.

viii. Equivalent financial statement shall mean the financial statement which is to be prepared as per the law of bidder's country.

ix. For the purpose of compliance of the stipulated turnover criteria given at Financial Criteria, the construction turnover from JV/Consortium(s) as declared in the Joint Venture/Consortium Agreement shall also be considered. The proportionate JV/Consortium turnover shall be certified by their statutory auditor if the same is not appearing in Audited Financial Statement.

x. For conversion from INR to NPR and vice versa, a factor of 1.6 will be considered.

5.5.3 Bid Capacity

The available Bid capacity of the Bidder for the participation in the present tender, calculated as under should not be less than INR 144 Crore.

Available Bid capacity = 2.0 x A x N - B

Where;

A= Indexed value of maximum value of works executed (in an on-going or completed project) in any one year during last 20 years, keeping index of inflation as 6% (compounded annually) for calculating A at present Price Level.

N = Number of years prescribed for completion of the subject contract package

B = Value of existing commitments (as on bid submission date) and on-going works to be completed in next "N" years.

Note: The information related to the maximum value of works executed in any one year during the last 20 years and existing commitments including ongoing works shall be supported with a certificate from the Statutory Auditor/ a Chartered Accountant firm.

6.0 Nature of Bidders

The bidder should either be a single entity from India Or a Joint Venture (JV) / Consortium of Indian firms Or Joint Venture/Consortium of Indian and Nepalese firms

(Indian bidder as lead partner) formed for participating in the tendering for this project. The bidder shall be allowed to associate sub-contractor(s) for certain components in which he does not have the requisite experience.

For evaluation of specific construction experience of various Bidders, following criteria shall be considered:

i. The evaluation of Bidder's specific construction experience for a work executed on JV basis shall be based on his role and scope of work in such joint ventures. To establish his role and scope of work in such Joint Venture contracts, the Bidders shall adduce documentary evidence to the extent of his claimed experience. In case the quantum of work as per experience certificate does not match with the scope of work as defined in the JV/consortium agreement, then the experience credentials shall be considered as per the experience certificate issued by the employer /client.

ii. In case scope of work of individual partners is not clearly defined in the JV/consortium agreement then credential of Bidders being partner in a JV/consortium shall be decided in the following manner:-

a. Where specific experience certificate in respect of individual JV partners is available, the same shall be considered to the extent of work executed by such JV partner.

b. Where specific experience certificate is not available, or experience certificate is issued in the name of JV/consortium, the evaluation shall be done in the following manner:-

i. In case the participation / profit sharing percentage of Bidders as per JV agreement is at least 35%, full credit of the work executed by the JV/consortium shall be given to such Bidders.

ii. In case the participation / profit sharing percentage of Bidders in JV agreement is less than 35%, no credit of work executed under such JV shall be given to such Bidders.

iii. Notwithstanding (i) and (ii) above, in case of availability of specific experience certificate, (a) above shall apply.

In case both participation share and profit sharing ratio are available in the JV Agreement, participation share shall prevail.

iii. For the portion of work executed through a sub-contractor, full experience for that portion of work can be claimed by the contractor as well as sub-contractor for fulfilling criteria for evaluation of Bidder's specific experience.

6.1 Joint Venture/Consortium Bidders:

Joint Venture or Consortium shall comply with the following minimum qualifying requirements:

(i) The number of partners in the Joint Venture/ Consortium including the Indian Lead Partner shall not exceed two (2).

(ii) The Lead Partner to fully meet the following:
- General construction experience criteria specified in para 5.5.1.1.
- Average annual construction turnover criteria based on % participation and shall not be less than 51% of criteria specified under Financial Criteria in para 5.5.2 (ii)
- Working Capital Criteria shall be based on the % participation as specified under Financial Criteria in para 5.5.2 (i) (b)
- Technical experience criteria as specified in para 5.5.1.3.
- Two or more of the Specific Criteria as specified in para 5.5.1.2

(iii) The other partner/member to individually meet the following:
- Average annual construction turnover criteria based on % participation and shall not be less than 20% of criteria specified under Financial Criteria in para 5.5.2 (ii)
- Working Capital Criteria shall be based on the % participation as specified under Financial Criteria in para 5.5.2 (i) (b)
- Two or more of the Specific Criteria as specified in para 5.5.1.2

(iv) The Technical Experience of each component structure to be met individually by the Lead partner and / or other partner as the case may be.

(v) All the partners of the Joint Venture/Consortium to individually fulfill the Net Worth criteria specified under Financial Capacity in para 5.5.2 (i) (a).

(vi) The Joint Venture/Consortium shall collectively satisfy, as a whole the Financial as well as Technical Requirements.

(vii) The Bid Capacity requirement shall be satisfied by individual partner of Joint Venture/Consortium in proportion to their participation share of works in Joint Venture

(viii) The parties shall be required to form the Joint Venture/Consortium before applying for the tender which shall be evinced by submitting a copy of the Joint Venture/Consortium agreement already entered into for the purpose. The Joint Venture/Consortium agreement should contain the roles and responsibilities of each constituent, the proposed participation share of each partner along with the items of work to be executed by each partner. It shall also be brought out in the Joint Venture/Consortium agreement that in case the Contract is awarded to the Joint Venture/Consortium, each partner of the Joint Venture/Consortium shall be

responsible for execution of that item of work for which he claims to have specific construction experience.

(ix) Lead partner of the Joint Venture/Consortium should be Indian company with at least 51% share.

6.2 Bidders with Sub-Contractors:

In case the Bidder does not have all requisite specific experience and also does not wish to enter into a Joint Venture or wants to restrict the joint venture partnership, he can associate sub-contractor(s) for specified activities as brought out below in para (iii) in which he does not have the relevant experience. The criteria to be met by such Bidders shall be as follows:

(i) The Bidder himself to fully meet the following:

- General construction experience criteria specified in para 5.5.1.
- All criteria mentioned under Financial capacity in para 5.5.2.
- Technical experience criteria as specified in para 5.5.1.3.
- Bid Capacity as mentioned in Para 5.5.3

The number of sub-contractor not to exceed one (1).

(ii) The Bidder can propose the subcontractor for 'Specific Construction experience', under para 5.5.1.2. (a) or 5.5.1.2 (b).

(iii) The proposed sub-contractor shall individually meet any one Specific Experience criteria for component listed in para 5.5.1.3.

(iv) The Bidder and his sub-contractor should submit separate undertakings that the Bidder/sub-contractors shall be responsible for execution of that item of work for which they claim to have specific construction experience.

(v) Sub-contractor shall submit Performance Bank Guarantee equivalent to 3% of value of Work sublet in addition to the Performance Bank Guarantee for whole contract submitted by the Bidders on award of Work.

6.3 Bids by Merged/ Acquired/ Subsidiary Companies:

In case of an Bidder's Company, formed after merger and/ or acquisition of other companies, past experience and other antecedents of the merged/acquired companies will be considered for qualification of such Bidders Company provided such Bidders Company continues to own the requisite assets and resources of the merged/ acquired companies needed for execution and successful implementation of the work package put to tender.

Similarly, if the Bidders Company is a subsidiary company and applies for qualification on the unconditional technical and financial strength of the Parent/ Holding company, the same shall be considered provided the Parent/ Holding company commits to sign a separate agreement with the Employer (in the Format included in the Forms and

Procedures of these Bid Documents) evincing full support for the technical and financial requirements of the subsidiary company and commit to take up the work itself in case of non-performance by the subsidiary company in the event of award of the work to the subsidiary company. An undertaking by the Parent/Holding company to this effect shall be submitted alongwith the bid (in the Format provided in the Bid Document).

For the purpose stated herein above in this clause, 'Parent Company' shall mean the 'Holding Company' owning majority shares of such Bidders (Subsidiary) Company. Similarly, by extensions of this interpretation, if "A" is owned by a 'Holding Company' "B" which in turn is owned by another Holding Company "C" then "C" is construed as the 'Parent Company' of "A" as well as and so on. An apex 'Parent Company' may own number of independent Subsidiary / Group Companies and if any of these Subsidiary/Group Company commits assured support and unhindered access to its assets and resources to another Subsidiary/Group Company (Bidders in this case) under the same apex 'Parent Company' then experience and other credentials of such Subsidiary/Group Company shall also be considered for qualification of the Bidders Subsidiary Company provided such commitment is evidenced/authorized and guaranteed by the apex 'Parent Company'.

In case Bidding Company (subsidiary company) gets qualified and awarded the work package, the Parent company/Holding Company will be required to furnish an additional performance bank guarantee of value equivalent to 3% (three percent) of the Contract Price or portion of work (where subsidiary Company is Joint Venture Partner) as the case may be, in addition to normal Performance Bank Guarantee to be submitted by the Bidder to the Employer besides entering into a separate Agreement in the requisite Format provided in the Bid Document. The experience of subsidiary companies of the Parent/ Holding Company will be considered experience of the Parent/ Holding Company.

However, for fulfillment of financial criteria, financial evaluation vis-s-vis the requirement as stated above shall be done on the basis of consolidated printed annual report for the immediately preceding 5 (five) years of the Parent/ Apex Parent Company submitted by the bidder along with the bid.

6.4 The Bidder shall also submit detailed proposals outlining bidders proposed methodology of construction backed with their equipment planning and deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, demonstrating their capability of achieving the completion of Works as per specified Interim Contract Milestones within the stipulated Time for Completion referred to in Appendix to Tender.

7. COST OF BIDDING

7.1 The bidder shall bear all costs associated with the preparation and submission of its bid, and the Employer will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

8. SITE VISIT

8.1 The bidders in their own interest, should inspect and examine the site and its surroundings and satisfy themselves, before submitting their bid, in respect of the site conditions

including but not restricted to the following which may influence or affect the Works or cost thereof under the Contract:

a) Site conditions including access to the Site, existing and required roads and other means of transport/ communication for use by them in connection with the Works;
b) Requirement and availability of land and other facilities, for their enabling works, colonies, stores and workshops etc., Such land shall be arranged by the Contractor at his own cost;
c) Ground conditions including those bearing upon transportation, disposal, handling and storage of materials required for the work or obtained there from;
d) Source and extent of availability of suitable materials including water, etc. and labour (skilled and un-skilled), required for Works and laws and regulations governing their use and employment;
e) Geological, meteorological, topographical and other general features of the site and its surroundings as are pertaining to and needed for the performance of the Works;
f) The limit and extent of surface and sub-surface water to be encountered during the performance of the Works and the requirement of drainage and pumping;
g) The type of Equipment and facilities needed, preliminary to, for and in the performance of the Works; and
h) All other information pertaining to and needed for the Works including information as to the risks, contingencies and other circumstances which may influence or affect the work or the cost thereof under this Contract.
i) Environmental aspects.
j) All applicable taxes, duties, royalty, cess, octroi etc.
k) Feasibility and adequacy of extracting material from the identified quarries.

8.2 The bidders should note that information, if any, in regard to the site and local conditions, in these Bid Documents is indicative only and has been given merely to assist the bidders and is not exhaustive.

8.3 The bidders should note and keep in mind that the Employer shall bear no responsibility for former's lack of acquaintance of the Site and other conditions or any information relating thereto. The consequences of the lack of any knowledge, as aforesaid, on the part of the bidders shall be at their risk and cost and no charges or claims whatsoever consequent upon the lack of any information, knowledge or understanding shall be entertained or payable by the Employer.

8.4 The bidder and any of its personnel or agents will be granted permission by the Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder, its personnel, and agents, will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

8.5 The bidders should note and bear in mind that the costs of visiting the Site shall be at the bidder's own expenses.

8.6 The site visit report shall form part of Attachment –5, 'Bidder's Appreciation of the Project' as per requirement of sub-clause 13.2 (e) of ITB.

B. BID DOCUMENTS

9. CONTENT OF BID DOCUMENTS

9.1 The Bid Documents are those stated below, and should be read in conjunction with any Addenda issued in accordance with Clause 11:

Volume-0	Section-0	Press Notice, NIT, Information for Bidders (IFB)
Volume-1	Section-1	Instructions to Bidders (ITB), Bid Data & Qualification forms
Volume-2	Section-2 Section 3 Section-4	General Conditions of the Contract (FIDIC), First Edition 1999 Particular Conditions of the Contract and Appendix to Tender Forms & Procedure • Letter of Tender • Form of Agreement • Performance Security Form for Bank Guarantee • Performance Security Bank Guarantee (to be submitted by Sub-Contractor) • Performance Security Bank Guarantee (to be submitted by Partner of JV) • Bank Guarantee Form for Advance Payment • Form of Taking Over Certificate • Bank Guarantee Form for release /payment of Retention Money. • Performa of Joint Deed of Undertaking by the Sub-Contractor and the Bidder/Contractor. • Undertaking by the Sub-Contractor • Undertaking by the Parent/holding Company • Parent/holding Company Agreement (sole bidder) • Parent/holding Company Agreement (For Joint Venture/Consortium) • Form of Joint Venture/Consortium Agreement • Hindrance Register
Volume-3	Section -5	Bill of Quantities.
Volume-4	Section -6	Technical Specifications.
Volume-5	Section -7	Tender Drawings.
Volume-6	Section -8	Data Sheets.

The Bid documents up to 5 MBs only can be uploaded as “single document” at the portal. As such bid documents having size more than 5 MBs shall be loaded in the form of Multiple documents at the portal.

10. CLARIFICATION OF BID DOCUMENTS

10.1 A prospective Bidder requiring any clarification on the Bid Documents may notify the Employer through e-mail to pnc.sapdc@gmail.com. The Employer will respond to such

requests through the websites www.sapdc.com.np, www.sjvn.nic.in & www.eprocure.gov.in which are received within the period mentioned as per Sr. No. 10.3 of NIT. Any clarification requiring an amendment to the Bid Documents shall be issued as Addenda as per the Clause 11. The Employer shall not be obliged to respond to any request for clarification received later than the above period. Further, the mere request for clarification from the Bidders shall not be a ground for seeking extension in the deadline for submission of bids. Employer's response (including an explanation of the query but not identification of its source) will be uploaded on websites www.sapdc.com.np, www.sjvn.nic.in & www.eprocure.gov.in, where the bidder can see clarification/reply to query/ amendment to the Bid Documents, if any.

11. AMENDMENT TO BID DOCUMENTS

11.1 At any time prior to the deadline for submission of Bids, the Employer may, for any reason, whether at its own initiative, or in response to a clarification requested by a prospective Bidder, amend the Bid Documents by issuing Addenda.

11.2 Any Addendum thus issued shall be part of the Bid Documents pursuant to Sub- clause 9.1 and shall be communicated only through websites www.sapdc.com.np, www.sjvn.nic.in & www.eprocure.gov.in. The amendments to the Bid Documents will be binding on the bidders and the notification of the amendment on websites www.sapdc.com.np, www.sjvn.nic.in & www.eprocure.gov.in, shall be deemed to be construed that such amendment(s) to the Bid Documents have been taken into account by the Bidder in its bid.

11.3 To give prospective Bidders reasonable time in which to take an Addendum into account in preparing their Bids, the Employer shall extend as necessary the deadline for submission of Bids, in accordance with Clause 22 and notify on websites www.sapdc.com.np, www.sjvn.nic.in & www.eprocure.gov.in where all prospective bidders may see the extended deadline

C. PREPARATION OF BIDS

12. LANGUAGE OF BID

12.1 The Bid, and all correspondence and documents related to the Bid exchanged by the bidder and the Employer shall be written in English. Supporting documents and printed literature furnished by the Bidder may be in another language provided they are accompanied with a certificate of the authorized translator certifying therein an accurate translation of the relevant passages in the above stated language, in which case, for the purposes of interpretation of the Bid, the translation shall prevail.

13. DOCUMENTS COMPRISING THE BID

13.1 The Bid submitted by the Bidder shall comprise the following documents:

a) Letter of Tender duly completed and signed by the Bidder, together with all Attachments identified in Sub-Clause 13.2 below.
b) Bill of Quantities duly completed by the Bidder.

c) Data related to Qualifying requirements (including Qualification Forms, data for establishing bid capacity and Data Sheets).

13.2 Each Bidder shall submit with its bid the following attachments:

(a) Attachment-1: Bid Security

A bid security furnished in accordance with Clause 18.

(b) Attachment-2: Power of Attorney

A power of attorney, as per Sub-clause 5.1 (a), indicating that the person(s) signing the Bid has the authority to sign the Bid and that the Bid is binding upon the Bidder during the full period of its validity in accordance with Clause 17.

(c) Attachment-3: Bidder's Eligibility and Qualifications

Bids submitted by a joint venture or a consortium of firms/companies as partners shall comply with the following requirements:

(i) The bid has to be signed as per sub-clause 5.2 (b), so as to be legally binding on all partners

(ii) Authorization to carry out the bidding as per sub clause 5.2(b).

(iii) **"**The payments against the Contract shall be made to the joint venture/consortium".

(iv) All partners of the joint venture shall be liable jointly and severally for the execution of the contract in accordance with the contractual terms, and a statement to this effect shall be included in the authorization at (ii) above, as well as in the bid and in the Agreement (in case of a successful bid).

(v) A declaration in respect of the submitted bid conforming to the requirement of Sub-clause 5.1 (e).

(d) Attachment-4: Local Representation

If a foreign Bidder has engaged a Nepalese agent, it will be required to give the following details in its bid as per the format enclosed in the Bid Documents:

i) The name and address of the local agent;

ii) What service the agent renders; and

iii) The fixed amount of remuneration for the agent included in the offer;

The agency commission shall be indicated in the Letter of Tender and will be paid to the Bidder's agent in Nepal in Nepalese Rupees.

(e) Attachment 5: The Bidder's Appreciation of the Project

The Bidders appreciation of the project, should include a report on the site inspection carried out prior to submission of bid, and must demonstrate full awareness and understanding of all the principal technical and logistic problems related to transportation and erection of the Equipment, construction of Works, Materials, availability of land and Infrastructures, local taxes/ duties/ royalties/levies/cess & Laws applicable for Construction Works. The site visit report shall form part of this Attachment.

(f) Attachment 6: Bids with sub-contractor:

Bids submitted by a bidder with sub-contractor shall comply with the following requirements:

(i) Undertakings by the Bidder and his sub-contractor that the Bidder /sub-contractors shall be responsible for execution of that item of work for which they claim to have specific construction experience.

(ii) A Joint Deed of Undertaking by the Bidder and his sub-contractor.

(g) Attachment 7: Bids by a Merged/Acquired/subsidiary company:

Bids submitted by a Merged/Acquired/subsidiary company shall comply with the following requirements:

Undertaking by the Parent/ Holding Company evincing full technical and financial support to the subsidiary and commitment by the parent / Holding company to take up the work itself in case of non- performance of the subsidiary company and to provide additional performance guarantee and also to enter into separate agreement with the Employer to that effect.

(h) Attachment-8: Integrity Pact alongwith Undertaking regarding Blacklisting.

Integrity Pact alongwith Undertaking regarding Blacklisting in accordance with Sub-Clause- 3.2.

(i) Attachment-9: Joint Venture/Consortium Agreement (attested by Notary Public) and signed between Lead Partner and the other Partner(s) of JV/C as per format included in Bid Document.

#.....

 # (Any other Attachment, if required, shall be attached with letter of Tender)

14. LETTER OF TENDER AND BILL OF QUANTITIES

14.1 The Bidder shall complete the Letter of Tender and the appropriate Bill of Quantities furnished in the Bid Documents as indicated therein and in the Sub-section "Letter of Tender" and "Bill of Quantities" of the Bid Documents, following the requirements of Clauses 15 and 16.

15 BID PRICE

15.1 Unless stated otherwise in the Bid Documents, the Contract shall be for the whole Works as described in Sub-clause 1.1, based on the unit rates and prices in the Bill of Quantities submitted by the bidder.

15.2 The bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities except for items of *'Cement variation'*. Items against which no rate or price is entered by the Bidder will not be paid for by the Employer when executed and shall be deemed covered by the rates for other items and prices in the Bill of Quantities. The bidder shall offer rates in all the BOQ items (including 'Dewatering' which is a 'fixed rate item') uploaded on portal https://etender.sjvn.co.in/SRMLogin/SRMLogin.jsp. However, the bidder shall fill the rates for item 'Cement Variation' for all the sections of BOQ, which is also a fixed rate item, and upload the scanned copy of same in Part-II on above portal only. Any indication of BOQ/price schedules or/and Fixed Rate Items in Part-I of bid shall lead to outrightly rejection of bid.

15.3 There is no provision in the tender for offering of rebate/discount as the bid evaluation shall be carried out on the basis of e-tender/e-Reverse Auction (e-RA) process under clause 30.4.

15.4 All duties, taxes, and other levies (except royalty charges, rents etc. which shall be dealt separately as stipulated under sub-clause 7.8 of PCC) payable by the Contractor under the Contract, shall subject to clause 15.5 herein be included in the rates and prices and the total Bid Price submitted by the bidder.

15.5 Unless otherwise provided in the Bid Data and Particular Conditions, the rates and prices are subject to adjustment during the performance of the contract in accordance with the relevant provisions of contract.

15.6 **Price bid Under Envelope-II shall be submitted as per Sub-clause 15.2 through SJVN e- portal i.e. https://etender.sjvn.co.in/SRMLogin/SRMLogin.jsp only (by filling price part in electronic form/template & uploading soft/scanned copy of Dully filled, Signed & stamped of bid form, if any, under Envelope-II) (i.e., Not in Hard copy), any other mode of submission of price bid part shall not be accepted**.

16. CURRENCIES OF BID AND PAYMENT

16.1 The unit rates and prices shall be quoted by the bidders separately in the following currencies:

a) In Nepalese Rupees for those inputs to the Works which the bidder expects to supply from within the Employer's country, and

b) In Indian Rupees for those inputs to the Works which the bidder expects to supply from outside the Employer's country. (referred to as "the foreign currency requirements").

For conversion from INR to NPR and vice versa, a factor of 1.6 will be considered.

17. BID VALIDITY

17.1 Bids shall remain valid for the period stipulated in the Bid Data from the date of opening of Technical Bid specified in Clause 25.

17.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request the bidders to extend the period of bid validity for a specified additional period. The request and the responses thereto shall be made in writing or by e-mail. A bidder may refuse the request without forfeiting its bid security. A bidder agreeing to the request will not be required or permitted to modify its bid, but will be required to extend the validity of its bid security for the period of the extension, and in compliance with Clause 18 in all respects.

18 BID SECURITY

18.1 The bidder shall furnish, as part of its bid, a bid security for the amount stipulated in the Bid Data in the Nepalese Rupees or in Indian Rupees.

18.2 The bid security shall be in the form of

i. Bank Guarantee from any "A" class Bank in Nepal for the amounts expressed in Nepalese Rupees (NPR). The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal.

Bank Guarantee for Bid Security in original shall be submitted along with the bid.

The format of the bank guarantee shall be in accordance with the form of bid security included in Section 4. Bid securities shall remain valid for a period of 90 days, beyond the original validity period of the bid or beyond any period of extension subsequently requested under sub-clause 17.2.

OR

ii. FDR duly pledged in favour of SJVN Arun-3 Power Development Company Pvt. Ltd.

OR

iii. Demand Draft/Managers Cheque endorsed in favour of SJVN Arun-3 Power Development Company Pvt. Ltd.

The FDR/DD/Managers Cheque issued by a "A" Class Nepalese Bank shall only be acceptable.

iv. Alternatively, payment against Bid Security/EMD may also be made directly in the following bank account of SJVN Arun-3 Power Development Company Pvt. Ltd. However, proof of same shall be submitted by the Firm/agency with the Proposal in Part-I (Envelope-I):

NPR Account Details:
Name of Bank: Everest Bank Limited, Nepal
Name of beneficiary: "SAPDC- NPR CONSTRUCTION ACCOUNT"
Acc. No. 00800105200477
Swift Code: EVBLNPKA

*****Bidder shall be responsible to ensure the receipt of net amount (excluding bank transfer charges) in the account before last date of submission of bid. Further, the bidder shall submit the copy of receipt in Envelope/Cover (**Part -I**) of the bid.

18.3 Any Bid not accompanied by an acceptable Bid Security and Letter of Tender together with its attachments shall be rejected by the Employer as non-responsive. The bid security of a joint venture must be in the name of the individual partner of Joint Venture in proportion of its participation in joint venture submitting the bid.

18.4 The Bid Securities of all the unsuccessful bidders will be returned as below:

a) The Bid Security of those Bidders, who do not qualify in Techno-Commercial evaluation, shall be returned immediately after opening the Price Bids of Techno-Commercially responsive bidders.

b) The Bid Security of the Bidders other than L-1 Bidder, shall be returned within 30(thirty) days from the date of issue of 'Letter of Acceptance' to the successful Bidder."

No interest shall be payable on the amount of security.

18.5 The Bid Security of the successful Bidder will be returned when the Bidder has signed the Agreement and furnished the required performance security.

18.6 The Bid Security shall be forfeited if:

a) The Bidder withdraws its Bid or varies any terms & conditions in regard thereto during period of bid validity or;

b) In the case of a successful Bidder, if he fails within the specified time limit to;
   (i) Sign the Agreement, or
   (ii) Furnish the required performance security.

c) If the Bidder adopts corrupt or collusive or coercive or fraudulent practices covered under ITB Clause-37.

19. ***Deleted without change in Sr. No.***

20. FORMAT AND SIGNING OF BID

20.1 The Bidder shall prepare the documents comprising the Bid as described in Clause 13 of these Instructions to Bidders.

20.2 The Bid shall be signed (Digitally and Physically) by a person duly authorized to sign on behalf of the Bidder, pursuant to Sub-clause 5.1(a) or 5.2 (b), as the case may be.

20.3 The Bid shall contain no overwriting, alterations, omissions, or additions, unless such corrections are initialed by the person or persons signing the Bid. Corrections if any shall only be made by scoring out the cancelled portion, writing the correction, initialing and dating it by the person or persons signing the Bid.

20.4 The Bids shall be signed as under:

a) If the Bid is submitted by an individual, it shall be signed by the proprietor above his full name and name of the firm with its current business address.

b) If the Bid is submitted by a proprietary firm, it shall be signed by the proprietor.

c) If the Bid is submitted by a firm in partnership, it shall be signed by a partner holding the power of attorney. A certified copy of the partnership deed duly registered and current business address of all the partners of the firm shall also accompany the Bid.

d) If the Bid is submitted by a limited company, it shall be signed by a duly authorized person holding the power of attorney together with a Board resolution in this regard for signing the Bid, in which case a certified copy of the power of attorney supported with resolution of Board of Directors shall accompany the Bid. Such limited company may be required to furnish satisfactory evidence of its existence before the contract is awarded.

e) All witnesses and sureties shall be persons of status and their full names, occupations and addresses shall be stated below their signatures.

D. SUBMISSION OF BIDS

21. PREPARATION, UPLOADING AND SUBMISSION OF BIDS

21.1 Bids shall be submitted online and physically in single stage with contents indicated in paragraphs 21.2 and 21.3 below. In the first Envelope, Qualification Particulars and Techno-commercial Bid shall be submitted. The Techno-commercial bid of only those bidders who meet the qualifying criteria shall be evaluated. After Techno-commercial evaluation, the Price Bids of Bidders whose Techno-commercial proposals are found responsive shall be opened online.

The bid should be serially numbered and properly indexed mentioning all constituents of bid including any enclosures/attachments etc. and their location page numbers in the bid. Failure to submit the bid in systematic manner as above may result in oversight of any important information provided by the bidder for which Employer shall not be responsible.

The bid shall consist of two parts as mentioned under sub-clause 21.2 and 21.3 hereunder:

21.2 **Part-I (To be submitted online as well as physically):** Envelope –I Bid (Qualification Particulars and Techno-commercial Bid) shall contain the following:

a) The Letter of Tender, duly filled in and signed without indicating the prices.
b) Cost of Tender Document and Bid Security in the form of Bank Guarantee/FDR/DD/Proof of direct online payment.
c) Bidding Forms, Qualification information and all Attachments mentioned in Clause 13.2 of ITB.
d) All Data Sheets, duly completed.
e) All documents specified under Envelope-II without indicating any prices therein.

f) All information and other data required to be submitted by Bidders in accordance with the Instructions to Bidders and the Addenda, including all supporting documentation, which the Bidder wishes to submit as part of his Techno-commercial Bid.

All bidding forms and data sheets relating to prices or having other financial implications shall be left blank, which must also contain no other information, data and details relating to prices. The above documents shall be digitally and physically (for online and physical/offline submission respectively) signed by the Bidder. The bidder shall not give any indication about the bid price in any manner whatsoever in the "Techno-Commercial" part of the bid. Non-compliance of this provision shall result in the rejection of bid.

21.3 **Part-II:** Envelope-II (Price Bid: Online only) shall contain the following:

a) The Letter of Tender, complete in all respects and duly signed.

b) The Price Bid duly filled in electronic form in conformity with the tender specification on the portal only.

Price bid Under Envelope-II shall be submitted as per Sub-clause 15.2 through SJVN e- portal i.e. https://etender.sjvn.co.in/SRMLogin/SRMLogin.jsp only (by filling price part in electronic form/template & uploading soft/scanned copy of Dully filled, Signed & stamped of bid form, if any, under Envelope-II) (i.e., Not in Hard copy), any other mode of submission of price bid part shall not be accepted.

Submission of Soft Copy of any documents by any other means shall not be accepted by the Employer in any circumstances.

c) All other document/data required as per the Instructions to Bidders or Addenda to be included in the Price Bid.

No material relating to any technical matters shall be included in the Price Bid.

21.4 All instructions in this respect contained in Section-1 (Instructions to Bidders) and Addenda, if any, shall be followed. The Envelope-I (Part-I Techno-commercial bid) has to be submitted in online mode and offline as well. However, Envelope-II (Part-II Price Bid) has to be uploaded online only as detailed under sub-clause 21.3.

21.5 **Marking of offline Submission:** The envelope containing hard copy of documents shall be marked as follows:

i. Part –I, of the bid shall be kept in a sealed envelope/cover duly super scribed with "Part-I - Bid security/EMD and Cost of Tender Document and Techno Commercial Bid" in Original.

ii. The envelopes/covers containing complete Part-I of the bid shall then be kept in a single cover and be sealed. The outer most cover would bear the following identifications:

On upper left hand corner.

- Bid for (Name of Work) & Tender No.
- Do not open before ……..

- To be opened by tender committee only.

In the center of the cover.

- Name of the person/ officer and the office address to whom bid is addressed.

On the bottom left hand corner:

- Name and address of the bidder.

The bidders must submit their bid either by post/courier or physically in the tender box kept at the address as mentioned in NIT prior to the last date for submission of bids. SAPDC shall not be responsible for any delay in receipt due to any reason whatsoever and/ or for loss of the bid in postal transit.

21.6 *Deleted without change in Sr. No.*

21.7 The bidder shall not give any indication about the bid price in any manner whatsoever in the "Techno-Commercial" part of the bid. Non-compliance of this provision shall result in the rejection of bid.

21.8 The inner and outer envelopes containing hard copy of documents shall;

a) be addressed to the Employer at the address provided in the Bid Data;
b) bear the name and identification number of the contract as defined in the Bid Data; and
c) provide a warning not to open before the time and date for bid opening, as specified in the Bid Data.

21.9 In addition to the identification required in Sub-clause 21.8, the envelopes shall indicate the name and address of the Bidder to enable the bid to be returned unopened in case it is declared "late" pursuant to Clause 22 and to identify pursuant to Clause 24.

21.10 If the envelopes are not sealed and marked as above, the Employer will assume no responsibility for the misplacement.

21.11 ***Deleted without change in Sr. No.***

22. DEADLINE FOR SUBMISSION OF BIDS

22.1 Complete Bids must be uploaded at the portal and hard copies of the documents mentioned in clause 21.2 of ITB must be received by the Employer at the address as specified in sub-clause 21.8 or bid data no later than the time and date stipulated in the Bid Data. In the event of the specified date for the submission of bids being declared a holiday for the Employer, the hard copy of the bid documents will be received up to the specified time on the next working day. However, the date and time for online submission of the bids shall continue to be the date and time specified in the Bid Data or any amendment for the same.

22.2 The Employer may, in exceptional circumstances and at its discretion, extend the deadline for submission of bids by issuing an Addendum in accordance with Clause 11,

in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

22.3 Further the Employer/SAPDC also reserves the right to extend bid submission timeline or recall if e-procurement server (i.e SJVN e-portal) is down (i.e inaccessible/inoperative) the tender for a prolonged period of time within the last 24 hours of the bid submission due date.

23. LATE BIDS

23.1 The bidder shall not be permitted to submit the Soft Copy Part of the bid after the deadline for submission prescribed in the bid data by the Employer/SAPDC. Any bid received from a bidder in Envelope /Cover (i.e., Part-I) physically by the SAPDC after the deadline prescribed by the SAPDC in accordance with clause -22.0 hereof will remain unopened. SAPDC shall not be responsible for any postal delay in respect of submission of the bid, however the e-Procurement system would not allow any late submission of bids through the portal https://etender.sjvn.co.in/SRMLogin/SRMLogin.jsp after due date & time as specified.
In case Hard copy part of the bid i.e Techno- commercial bid under 1st Envelope-I is not received till the deadline for submission of the same as prescribed by the Employer/SAPDC, but the bidder has uploaded the soft/scanned copy of the technical part of bid (i.e., the bid under first envelope). The uploaded technical bid on the portal shall be opened and such bid may be rejected during preliminary examination.
The bid received by the Employer/SAPDC after the deadline for submission as prescribed, will be considered as late bid. In such a case, the bids will be rejected.

24. MODIFICATION, SUBSTITUTION AND WITHDRAWAL OF BIDS

24.1 As per provisions in the tender document /e-portal only, the bidder may modify or withdraw the bid after submission, provided that modification is done on the e-portal as well as notice is received by the Employer/SAPDC prior to the deadline prescribed for bid submission.

24.2 The Bidder"s modifications shall be done and submitted as follows:

(i) Modified Electronic form of the bid as per the provision of portal therein.

(ii) Soft copy of the entire bid if any modification is there.

24.3 Any alteration/ modification in the Bid or additional information supplied subsequently to the Bid Due Date and time, shall be disregarded. The bidder's modification or notice of withdrawal shall be prepared, sealed, marked and delivered in accordance with the Para-5,20 & 21 hereof, with the inner envelopes additionally marked "Modification" or "Withdrawal" as appropriate.

24.4 No bid may be withdrawn in the interval between the bid submission deadline and the expiration of the bid validity period specified in ITB Clause 17. Withdrawal of a bid during this interval may result in the Bidder's forfeiture of its bid security, pursuant to ITB Sub-Clause 18.6

24.5 No bid may be modified subsequent to the deadline for submission of bids.

E. BID OPENING AND EVALUATION

25. BID OPENING

25.1 The Employer will open the Bids online and offline in the presence of Bidders' designated representatives who choose to attend, at the time, date, and location stipulated in the Bid Data. The Bidders' representatives who are present shall sign a register evidencing their attendance. No Bid shall be rejected at the Bid opening except for the late Bids pursuant to clause 23 hereof. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Para-24 hereof shall not be opened.

In case of non-submission of bid by the bidder in the portal (soft copy part of the bid) within the stipulated deadline, then even if the bidder has submitted the specific documents in hard copy part in original within the stipulated deadline pursuant to ITB 22.1, the said bid shall be considered as incomplete bid, which will be summarily rejected.

Similarly, in case of non-submission of Hard copy part of the bid, but the bidder has uploaded the soft copy part of the bid on e-portal as mentioned in tender document, the bid will be considered as incomplete bid. In such a case, the soft copy part of the first envelope bid uploaded on the portal shall be opened. Such bids will be rejected during preliminary examination.

The date of opening of Price Bids (Part-II) on online mode only shall be intimated/notified/communicated only through websites www.sapdc.com.np, www.sjvn.nic.in & www.eprocure.gov.in. Price Bids shall be opened on due time, date and place as specified in invitation letter by the Employer. Price Bids of the Bidders whose Bids not found Techno-commercially responsive shall not be considered for opening and shall not be considered at all any further. The envelope of modification pursuant to Para-24 hereof, if any, to this part of bid shall be opened first.

25.2 At the time of opening, all important information and any such other details as the Employer may consider appropriate, will be announced. This shall include but may not be limited to the Bidders' names, the Bid Prices including deviations and the presence (or absence) of bid security.

26. PROCESS TO BE CONFIDENTIAL

26.1 Information relating to the examination, clarification, evaluation and comparison of bids, and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award to the successful bidder has been announced. Any effort by a bidder to influence the Employer's processing of Bids or award decisions may result in the rejection of the bidder's bid.

27. CLARIFICATION OF BIDS

27.1 To assist in the examination, evaluation, and comparison of bids, the Employer may, at its discretion, ask any bidder for clarification of its Bid, including breakdowns of unit rates as per the format given in Data Sheet – 11 under Section 8. The request for clarification and the response shall be through e-mail but no change in the price or substance of the bid shall be sought, offered, or permitted except as required to confirm the correction of arithmetical errors discovered by the Employer in the evaluation of the Bids in accordance with Clause 28 hereof.

28. EXAMINATION OF BIDS AND DETERMINATION OF RESPONSIVENESS

28.1 The basis and methodology for evaluation of the Qualification Particulars and techno-commercial bids shall generally be as described in the supplement to Instructions to Bidders attached as Annexure-A to these ITB. The Employer will examine the bids to determine whether they are complete, whether any computational errors have been made, whether required securities and cost of Bid Document have been furnished, whether the documents have been properly signed, whether all the requisite declaration, undertakings have been furnished and whether the bids are generally in order.

28.2 The Price Bid shall be duly filled in electronic form in conformity with the tender specification on the portal only. The BoQ is to be filled in for filling rates of the items to be filled in by the Bidder The calculation of amount by multiplying the quantities with the rates filled in by the bidder, sub-totals, total etc. shall be done by formulae already provided in electronic form. In case of any discrepancy in the calculations, the rates shall be considered final and the amount calculated by using the same shall be corrected and considered as final. Where ever prices for items is left blank, in the BOQ, it shall be deemed to have been included in other items.

28.3 The Employer may waive any minor informality, non-conformity or irregularity in a bid that does not constitute a material deviation and that does not prejudice or affect the relative ranking of any Bidder as a result of the evaluation of Bids, pursuant to these Clauses.

28.4 Prior to the detailed evaluation, the Employer will determine whether each Bid is of acceptable quality, is complete and is substantially responsive to the Bid Documents. For purposes of this determination, a substantially responsive Bid is one that conforms to all the terms, conditions and specifications of the Bid Documents without material deviations, objections, conditionalities or reservations. A material deviation, objection, conditionality or reservation is one (i) that affects in any substantial way the scope, quality or performance of the Contract; (ii) that limits in any substantial way, inconsistent with the Bid Documents, the Employer's rights or the successful Bidder's obligations under the Contract; or (iii) whose rectification would unfairly affect the competitive position of other Bidders who are presenting substantially responsive bids.

The Employer's determination of a Bid's responsiveness is to be based on the content of the Bid itself without recourse to extrinsic evidence.

28.5 If a Bid is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

28.6 All the bidders shall be informed, about their status of qualification/ disqualification/techno-commercial responsiveness, in a single notification.

29 CONVERSION TO SINGLE CURRENCY FOR EVALUATION OF BIDS

29.1 For evaluating the price bids, the Employer will convert the amount quoted in various currencies in which the Bid Price is payable to the currency of the Employer's country using the exchange rate stated in the Bid data. For conversion from INR to NPR and vice versa, a factor of 1.6 will be considered.

30. EVALUATION AND COMPARISON OF BIDS

30.1 In evaluating the Price Bids, the Employer will determine for each Bid the Evaluated Bid Price by adjusting the Bid Price as follows:

a) making any correction for errors pursuant to Sub-clause 28.2;
b) converting the amount to a single currency in accordance with Clause 29;

30.2 The effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the contract, if any, shall not be taken into account in bid evaluation.

30.3 Any adjustments in price that result from the above procedures shall be carried out, for purposes of comparative evaluation only, to arrive at an "Evaluated Bid Price."

30.4 After arriving at L1 evaluated bid price through e-tender, the qualified bidders shall participate in E-Reverse auction process as follows:

30.4.1 Process:

a) Eligibility Criteria for participation in e-RA:
   i. Only techno-commercially responsive bidders with valid digital signature certificate, who participate in the initial e-tendering process, will be eligible to participate in the subsequent e-RA.
   ii. Where number of eligible bidders at Price bid stage is one, then work shall be awarded to sole bidder, if the price of sole bidder is found reasonable and acceptable to SAPDC.
   iii. Where number of eligible bidders at Price bid stage is two/three, then e-RA process will be conducted among all bidders.
   iv. Under no circumstances, there shall be less than two bidders participating in e-RA after elimination.
   v. In case of eligible bidders at Price bid stage is four or more than four then, the highest (H1) bidder shall not be eligible for e-RA and e-RA will be conducted among rest of the bidders.
b) e-RA will be done on total bid price and the unit rates of the successful bidder quoted in e-tender shall be reduced pro-rata to match with the e-RA bid price.

c) After technical evaluation of the bids & opening of price bids, the bidders, eligible for e-RA as per methodology above, will be intimated. Such qualified bidders shall be eligible to participate in the e-RA to be conducted by the e-procurement/e-RA service provider.

d) e-Procurement/e-RA service provider will guide the shortlisted bidders for this purpose and the Bidders shall abide by Business Rules for e-RA as specified hereinunder.

30.4.2 Start/Base Price: For e-RA, L1 evaluated bid price through e-tendering shall be taken as start/base price.

30.4.3 e-RA will be conducted on scheduled date & time which shall be conveyed to the eligible bidders through e-mail.

30.4.4 The start/base price and the minimum bid decrement value shall be available to qualified bidders only on the e-procurement website, sixty minutes before the start of e-RA Process.

30.4.5 The first online bid for e-RA shall be lesser than the price by minimum one decrement (0.1% of L-1 evaluated price). The subsequent online bids will be lesser than the first online bid by minimum one decrement value. The final bid shall prevail over the earlier bids.

30.4.6 The bidder will be able to view leading bid in the auction and/or his own rank, bid placed by him during the event, Opening Price and Decrement price on screen along with other necessary fields in the e-RA. Names of bidders shall be displayed as dummy names to maintain anonymity.

30.4.7 e-RA duration: The duration of e-RA shall be initially for a period of one hour. However, in case any bidder places a bid within the last 10 minutes before scheduled closing of the e-RA and if the bid gets accepted and happens to be lowest, the duration for e-RA shall be increased by a further period of 10 minutes beyond scheduled closing time.

Auto-extension: The auto-extension takes place only in the last 10 minutes and there will be no limits for number of auto-extensions. However, in case there is no bid in the last 10 minutes before the closing of e-RA, then e-RA shall get closed automatically.

30.4.8 Proxy Reverse Auction feature: It is a pro-bidder feature to safe guard bidder's interest against Internet failure or in case of bidders who don't wish to be present in entire e-RA duration but wish to quote a minimum price that is valid for them in entire e-RA duration. This feature allows bidders to place an automated bid against other bidders in the e-RA without having to enter revised bid again and again during the e-RA process. The proxy bid amount cannot be changed until the lowest bidding amount reaches the proxy bid amount, after which it can be lowered. Bids shall be submitted by the system on behalf of the proxy bidder in decrements i.e. decreasing bid amounts upto the proxy bid amount.

30.4.9 Bidders shall submit most competitive prices through e-tendering since these prices may be considered for final award in case e-RA event is not resorted to, due to reasons mentioned herein.

30.4.10 At the end of e-RA, the closing/final Price shall be available on screen. The ratio of closing/final price through e-RA and originally quoted price through e-tendering shall be applied on all elements of originally quoted price to arrive at the final price break up (i.e. unit rates) which shall be considered further for final award.

30.4.11 Loading: Techno-commercial cost loading (for non-compliance to Employer's terms and conditions as applicable), if any will be carried out/or the deviations taken by the bidder and to determine the lowest evaluated bid. It shall be intimated to bidders prior to e-RA event and it shall be added to the quoted prices of respective bidder. Accordingly, the bidder(s) during e-RA should submit prices inclusive of cost of withdrawal of their respective deviations and/or other loadings so evaluated and intimated by the Employer.

After the completion of e-RA, the Closing Price (CR) shall be available. In case, any commercial loading is made to L1 bidder's price, it shall be de-loaded from the closing price of L1 bidder (CP) for further arriving at final breakup (i.e., Unit Prices) and thereafter processing for award.

30.4.12 Cancellation: During e-RA, if no bid is received within the specified time duration of the e-RA, Employer, at its sole discretion, may decide to reschedule/scrap the e-RA process or finalize the tender based on Price Bids received through e-tendering if Employer does not decide to cancel/annul the tendering process for any reason and if the price of lowest bidder is found reasonable and acceptable to the Employer.

30.4.13 On the basis of these terms and conditions, Employer, at any time before the placement of order on successful bidder, shall be at liberty to cancel, extend, reschedule the e-RA process or finalize the tender based on Price Bids submitted through e-tendering without assigning any reason.

30.4.14 **Award:** On the conclusion of e-RA successful bidder shall be the one whose e-RA price is lowest if considered reasonable at the sole discretion of Employer.

30.4.15 Employer's decision for award of Contract shall be final and binding on all the bidders.

30.4.16 **Limitation of Liability:** Employer or its e-procurement/e-RA service provider shall not be liable & responsible to bidders in any manner whatsoever for failure to access/interruption/delay & bid on the e-RA platform due to loss of internet connectivity, power failure, virus attack, problems with the PC, any other unforeseen circumstances etc. before or during the auction event. On account of this, the time for the auction shall not be extended and Employer shall not be responsible for such

eventualities. Further, in such cases, the decision of Employer shall be binding on the bidders.

30.4.17 Employer reserves the right to modify/withdraw any of the Business rules, terms & conditions of e-RA at any point of time prior to commencement of e-RA. However, any modifications in Business rules, terms & conditions of e-RA shall be duly communicated to techno-commercially qualified bidders.

30.4.18 Employer will provide the calculation sheet to the bidders as applicable which will help them to arrive at the total cost to enable them to keep it ready during e-RA.

30.4.19 The e-RA would be carried out in Indian Rupees or foreign currency converted into equivalent Indian Rupees only, on the date mentioned in bid document.

30.4.20 **System Accessibility:** The login ID and password for participating in e-RA will be the same as the one given to bidders on registration on e-procurement portal.

30.4.21 In case of any issue w.r.t. e-RA not specifically dealt with in Business Rules, the decision of the Employer shall be final and binding on all concerned.

30.5 If the Bid, which results in the lowest Evaluated Bid Price pursuant to e-RA or otherwise, is front loaded in relation to the Employer's estimate of the items of work to be performed at early stage under the Contract, the Employer may require to furnish additional performance security, to cover front loading and valid up to completion of Works, set forth in Clause 35 hereof at the expense of the bidder to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.

F. AWARD OF CONTRACT

31. AWARD

31.1 Subject to Clause 32 hereunder, the Employer will award the contract to the Bidder, meeting the specified qualifying requirement and also whose Bid has been determined to be substantially responsive to the Bid Documents and who has offered the lowest Evaluated Bid Price pursuant to Clause 30, provided the Bidder has offered reasonable Bid Price compared to Employer’s estimated cost of Works.

32. EMPLOYER’S RIGHT TO ACCEPT ANY BID AND TO REJECT ANY OR ALL BIDS

32.1 The Employer reserves the right to accept or reject any Bid, or cancel/ withdraw invitation to Bid for any reason including national defense and security considerations, and annul the bidding process and reject all Bids at any time prior to award of contract, without thereby incurring any liability to the affected Bidder(s).

33. NOTIFICATION OF AWARD

33.1 Prior to expiration of the period of Bid validity prescribed by the Employer, the Employer will notify the successful Bidder by email that its Bid has been accepted. This letter (hereinafter and in the Conditions of the Contract) shall be called the "Letter of Acceptance" as prescribed by the Contract.

33.2 The notification of award (Letter of Acceptance) will constitute the formation of the contract until the contract has been effected pursuant to clause 34 hereunder.

33.3 The unsuccessful bidders shall also be informed simultaneously about their status of Bids.

33.4 The award details shall also be posted on www.sapdc.com.np. www.sjvn.nic.in and www.eprocure.gov.in.

34. SIGNING OF AGREEMENT

34.1 After notifying the successful Bidder that its Bid has been accepted, the Employer will prepare the Agreement in the form provided in the Bid Documents, incorporating all agreements between the parties. The contract shall be signed in two originals (one for Employer and one for Contractor). The Contractor shall provide to the Employer 8 sets of the Contract after its execution, free of charges. Also, after checking by the Employer, the Contractor shall provide to the Employer one set of the Contract in electronic form, free of charges.

34.2 After issue of Letter of Acceptance, the Employer shall notify the contractor about the readiness of the Agreement. The Employer and the successful Bidder shall sign the Agreement within 14 days from the date of issue of such notice to the contractor.

34.3 Upon issue of Letter of Acceptance as per clause 33 hereof, the Employer will notify the other Bidders that their Bids have been unsuccessful and their Bid Security will be returned within 30 days of issuance of Letter of Acceptance.

35. PERFORMANCE SECURITY

35.1 Within 28 days from the date of issue of Letter of Acceptance, the successful bidder shall furnish to the Employer a Performance Bank Guarantee in the form stipulated in the Conditions of Contract and additional Performance Security as per Clause ITB 30.5 above.

35.2 The bidders who are qualified on the strength of their sub-contractor shall be required to furnish an additional Performance Bank Guarantee from their sub-contractor as per Clause 4.2 of Particular Conditions of Contract.

35.3 In case Bidding Company (subsidiary company) gets qualified and awarded the work package, the Parent company/Holding Company, within 28 days from the date of issue of Letter of Acceptance, will be required to furnish an additional performance bank guarantee, as per Clause 4.2 of Particular Conditions of Contract, of value equivalent to (3%) three percent of the Accepted Contract Amount or portion of work (where

subsidiary Company is Joint Venture Partner) as the case may be, in addition to normal Performance Bank Guarantee to be submitted by the Bidder to the Employer besides entering into a separate agreement in the requisite Format provided in the Bid Document.

35.4 The form of Performance Bank Guarantee provided in Section 4, of the Bid Documents may be used

35.5 Failure of the successful bidder to comply with the requirements of Clause 34 or 35 hereof shall constitute a breach of Contract, cause for annulment of the award, forfeiture of the Bid Security, and any such other remedy the Employer may take under the provisions of the Contract.

36. PERMANENT ACCOUNT NUMBER (PAN)

Within 28 days from the date of issue of the Letter of Acceptance, the successful Bidder shall furnish to the Employer his Permanent Account Number issued by the income tax authorities in Nepal. No payment shall be made to the Contractor unless he submits his Permanent Account Number.

37. CORRUPT OR FRAUDULENT PRACTICES

37.1 It is expected from the Bidders that they will observe the high standard of ethics during the bidding process and execution of such Contracts. In pursuance of this policy:

(a) For the purpose of this provision, the terms set-forth below shall mean as under:

(i) "corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the procurement process or in Contract execution.

(ii) "fraudulent practice" means a misrepresentation or omission of facts in order to influence a procurement process or the execution of a Contract

(iii) "collusive Practice" means a scheme or arrangement between two or more bidders, with or without the knowledge of Client, designed to establish bid prices at artificial, non-competitive levels.

(iv) "coercive Practice" means harming or threatening to harm, directly or indirectly, person or their property to influence or affect the execution of Contract.

(b) A Bid shall be rejected by the Employer if it is determined at any stage that respective Bidder has engaged in corrupt or fraudulent or Collusive or Coercive practices in competing for or in executing the Contract in question and his Bid Security shall be forfeited. The Contractor shall not be entitled for any compensation whatsoever under this clause.

(c) The Employer may declare a bidder ineligible, either indefinitely or for a stated period of time, to be awarded a Contract if it at any time determines that the bidder has engaged in corrupt or fraudulent or collusive or coercive practices in competing for, or in executing a Contract.

(d) The documents/information submitted by Contractor may be verified by the officials of the Employer for its authenticity at any time and the Contractor shall provide all facilities/co-operation in this regard. If it is found that any of the documents/information submitted by the Contractor is not genuine, the Employer shall have full rights to cancel his Bid, forfeit the bid security and terminate the Contract, if awarded.

38. E-Payment

The Successful Bidder/Contractor shall have to furnish the following information for receiving payments against the Work through e-payment system:

1. Name of Beneficiaries:
2. Name of the Bank:
3. Branch of the Bank:
4. Account No.:
5. Swift Code/IFSC Code/RTGS Code:
6. City/Town:
7. Fax No.:
8. Telephone No.:
9. E-mail address:

39. Integrity Pact:-

39.1 To improve transparency and fairness in the tendering process the Employer is implementing Integrity Pact. Integrity Pact is deemed as part of the contract so that the prospective bidders are bound by its provisions.

The Integrity Pact, signed by all the prospective Bidders and the Employer, shall commit the persons/officials of both the parties, not to exercise any corrupt/fraudulent/collusive/coercive practices in the Tendering process and also during implementation of the Contract. Only those Bidders who have entered into Integrity Pact with the Employer shall be eligible to participate in the bidding process. Bidders signing Integrity Pact shall not approach the Courts while representing the matters to IEMs and he/she will await their decision in the matter.

Entering into Integrity Pact as per Performa (enclosed at Attachment-8) is a basic qualifying requirement. In case of JV, each partner of JV shall sign Integrity Pact with the Employer. In case of sub-contracting, the Principal contractor shall be responsible for adoption of Integrity Pact by the sub-contractor.

To oversee the compliance of obligation under the Integrity Pact, a panel of Independent External Monitor(s) (IEMs) have been appointed by concerned authority. The Contact address of IEMs are as under:

Sl. No.	Name of IEMs	Address of IEMs
1	**Sh. S.P. Srivastava, IPS (Retd.)**	1/125, Vineet Khand, Gomtinagar, Lucknow, UP-226010 Email: sps_ips@yahoo.com
2	**Smt. Archana Pandey Tiwari, IRS (Retd.)**	C-32, Nangal Dewat, Vasant Kunj, New Delhi-110070 Email: ampandey2001@yahoo.com

The Integrity Pact duly signed on behalf of SAPDC is enclosed at **Attachment-8** of the Bid Documents. The Integrity Pact shall be downloaded, printed and signed by the bidder and the hard copy shall be submitted in Part-I (Envelope-I) of Bid.

39.2 The successful bidder shall submit duly executed Integrity Pact on Plain Paper prior to signing of Contract Agreement.

Annexure-A
(ITB Cl 28.1)

1.0 **Technical Evaluation**:

Technical Evaluation shall be carried out on the basis of technical submission by the Bidder, which will include the information and data provided by Bidders as specified in the Data Sheets:

i) Work Commitment (Data Sheet 1)
ii) Personnel capabilities; Personnel Candidate data (Data Sheet 2 and 2A).
iii) Equipment Data (Data Sheet 3, 3A& 3B).
iv) Financial Data (Data Sheet 4)
v) Proposed Site Organization, (Data Sheet 5).
vi) Proposed Sub-Contractor (Data Sheet 6)
vii) Construction Programme (Data Sheet 7)
viii) Construction Methodology (Data Sheet 8)
ix) Quality control organization and procedures

2.0 In addition, the Bidders are expected to provide full details of Procedures for coordinating Works with other contractors and suppliers, as well as with the Employer in such a way as to avoid delays or other difficulties during the construction of Works.

2.1 To facilitate completion of the technical evaluation in the limited time available, Bidders are advised.

- To submit their technical documentation and all other data in the form and order indicated in the data sheets and/or as instructed above, and to ensure that all specific points on which information has to be submitted, as detailed in the Instructions to Bidders and any addenda thereto, are fully covered.
- To ensure that the documentation submitted is complete in all respects but also concise.

2.2 As the Programme for Bid evaluation is short, the Employer cannot accept any obligation to request clarifications or substantiating information after bids have been submitted.

3.0 (a) Even though the bidders meet the qualifying criteria as per clause no 5. 5 (ITB), they are subject to be disqualified if they have:

(i) made misleading or false representations in the forms, statements, declarations and attachments submitted in proof of the qualification requirements; and/or
(ii) record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.
(iii) participated in the previous bidding for the same work and had quoted abnormally high or low bid prices and could not furnish rational justification for it to the Employer.

BID DATA

The following specific data for the Works to be procured shall complement, amend, or supplement the provisions in the Instructions to Bidders (ITB). Whenever there is a conflict, the provisions herein shall prevail over those in Instructions to Bidders

Instructions to Bidders (ITB) Clause Reference	
1.1	**Summary of Works:** Package C-7: Civil works of Tail Race Pond, outfall of Arun-3 HEP and Intake Structure with Tunnel located in Sankhwasabha Distt. of Nepal.
1.3	**Name and Address of the Employer:** SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC), Satluj Bhawan, Arun Sadan, Tumlingtar, Distt. Sankhuwasabha, Nepal
1.	**Period of Completion 09** Months
5.1	**Qualifying Requirement:** The Bidder who wishes to participate in the bid should satisfactorily meet the qualifying requirements stipulated in ITB Clause-5.5
10.1	**Clarifications on bid document (if required):** 10 days prior to last date of bid submission mentioned in Sr. No. 10.3 of NIT which shall be responded to and clarified as per clause 11.0 of ITB
15.5	The Contract is subject to price adjustment as provided in Clause-13.8 of Particular Conditions of Contract.
16	**Country of the Employer**: Nepal
16	**Currency of the Employer's Country:** Nepalese Rupees
17.1	**Period of Bid Validity:** 180 days
18.1	**Amount of Bid Security/EMD:** INR 1,53,35,000/- (Indian Rupees One Crore Fifty Three Lakh and Thirty Five Thousand only) OR NPR 2,45,36,000/- (Nepalese Rupees Two Crore Forty Five Lakh and Thirty Six Thousand only)
18.2	**Bank details for Bid security:** **NPR Account Details:**

	Name of Bank: Everest Bank Limited, Nepal **Name of beneficiary: "SAPDC- NPR CONSTRUCTION ACCOUNT"** **Acc. No. 00800105200477** **Swift Code: EVBLNPKA**
21.8 (a)	**Address for the purpose of hard copies of bid submission:** O/o Chief Engineer (P&C), Satluj Bhawan, Arun Sadan, Tumlingtar, Distt. Sankhuwasabha, Nepal.
21.8 (b)	**Number of the Contract:** DCB-P&C-AHEP-C-7/2023-103
22	Online & Offline Submission: up to 10.03.2023 (1500 Hrs. IST) **O/o Chief Engineer (P&C), SAPDC, Satluj Bhawan, Tumlingtar, Distt. Sankhuwasabha, Nepal, Ph. +977-29-575154, 9852099789** **OR** **O/o Company Secretary, SJVN Arun- 3 Power Development Company (SAPDC), 3rd floor, Citizen Investment Trust (CIT) Building, New Baneshwor, Kathmandu, Nepal**. Contact No: +977 9819822967
25	**Venue, time and date of bid opening:** **Venue:** O/o Chief Engineer (P&C), Satluj Bhawan, Arun Sadan, Tumlingtar, Distt. Sankhuwasabha, Nepal **Time and Date:** **Techno- Commercial Bid (Part--I):** Online & offline Bid opening on 13.03.2023 at 1600 Hrs. (IST) **Price Bid (Part--II):** Online bid Opening- shall be notified later on, separately on following websites: www.sapdc.com.np**, www.**sjvn.nic.in/tender.htm**, &** www.**eprocure.gov.in** (Only i.r.o. the bidders meeting the specified qualifying criteria and also whose Techno-Commercial Bids are found responsive).
29.1	**Currency chosen for the purpose of converting to a common currency:** Nepalese Rupees **Source of Exchange Rate:** For conversion from INR to NPR and vice versa, a factor of 1.6 will be considered.

QUALIFICATION FORMS

(Refer ITB sub-clause 13.1 (c))

APPLICATION FORM - 1 PAGE ___ OF ___ PAGES

General Information

Bidders are requested to complete the information in this form.

1.	Name of firm	In case of joint venture/consortium/sub-contractor ( ) Lead Partner ( ) Partner ( ) Sub-contractor
2.	Head office address *Country*:	
3.	Telephone Fax Email	Contact Person(s) Name Title/Position
4.	Place of incorporation / registration Date	
5.	Legal status of firm	Field of specialty in business
6.	Nationality of majority of owners or share-holders	Number of management executives _____ persons
7.	Number of present permanent employees: (unit: persons) Name of Country / Civil Engineers / Other Engrs. / Non-Engineering Home country Overseas branch 1 Overseas branch 2 All other branches	
8.	Quality assurance system in head office	Certified by:
9.	Agent or representative in Nepal Name Address Telephone	(if exists) Fax & Email

Date _____ Signature _____

APPLICATION FORM - 2 PAGE ___ OF ___ PAGES

General Experience Record

Name of the Construction Company (Sole Bidder) or Partner/member of a Joint venture/Consortium

Bidders are requested to complete the information in this form.
Use a separate sheet for each Partner/member of a joint venture/consortium.

1. Average Annual Construction Turnover

The information supplied should be the annual construction turnover of the Bidder (separately for each partner of a joint venture/ each member of a consortium), in terms of the amounts paid by the clients for each year in the preceding 2 (two) years ,converted to INR at the rate of exchange at the end of the period reported. Unless specifically asked for, Bidders need not to enclose testimonials, certificates, and publicity material with their applications, they will not be taken into account in the evaluation of qualifications.

Fiscal Year	Construction Turnover (unit)	INR equivalent*
1.		
2.		

Fiscal year begins on _____ in each calendar year.

2. General Experience

The Bidder as Sole Contractor or Partner of a Joint Venture/Consortium or Sub-Contractor approved by the respective employer, should have experience of executing (includes completed and ongoing projects) a Works Contract of value at least INR 72 Crore in the preceding 15 years.

No.	Name of Project	Country	Bidder's own works done	Role of the Bidder (sole contractor, or partner in JV/Consortium or Approved Sub-contractor)	Contract period m/yr to m/yr	Bidder's contract price (INR equivalent)*
1						
2						
3						
4						

* i) Exchange rate as on date of award of Contract.
ii) Mention exchange rate adopted.

Date _____ Signature _____

NB : To please attach detailed data sheet wherever possible.

APPLICATION FORM - 2A PAGE ___ OF ___ PAGES

Joint Venture/Consortium Summary

In case of joint venture/consortium, this form is requested to be filled and attached to Form 2.

1. Members of Joint Venture/Consortium

Names of all Partners of a joint venture		Proposed participation	Proposed portion of work
1. Lead Partner		%	
2. Partner		%	

2. Summary of Average Annual Construction Turnover

Total value of Average Annual Construction Turnover, in terms of work paid by the clients, in INR equivalent converted at the rate of exchange at the end of the period reported:

		Annual Construction Turnover – Summary (INR equivalent)	
Partner	Form 2 page no.	Year 1	Year 2
1. Lead Partner			
2. Partner			
Total			

Indicate responsibility in respect of planning, Equipment, key personnel and execution of the work of the lead firm of the joint venture/consortium and of each of the joint venture/consortium partners.

Date _____ Signature _____
by Lead Partner

APPLICATION FORM-3 PAGE ____OF____ PAGES

Construction Experience Record

Name of Construction Company (Sole Bidder); Partner of a joint venture/consortium and/or sub-contractor:

On a separate page, using the format of Form-3A, each firm (Sole Bidder); Partner of a joint venture/consortium and/or sub-contractor is requested to list all contracts of a similar nature undertaken and completed in past or ongoing, on the basis of which the Bidder wishes to qualify. The Specific Construction Experience should include the following:

Technical Experience:

i) Completion of tunnel of minimum 50 m length and 8m finished dia. with Drill and Blast Method. Completion of tunnel means completion of excavation and lining of at least 50 m length and 8m finished dia. Tunnel

ii) Open/underground excavation having quantity 1,03,000 m^3 in any single Hydro Electric project.

Specific Criteria:

(a) Experience of executing (includes completed and ongoing projects) at least one civil work involving excavation / earth work of 1,03,000 m^3 or more in a single contract in last 20 years.

(b) Experience of achieving progress rate of execution of at least 1,03,000 m^3 excavation / earth work for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years.

(c) Experience of executing (includes completed and ongoing projects) at least one civil work involving concrete quantities of 30,900 m^3 or more in a single contract in last 20 years.

(d) Experience of achieving progress rate of execution of at least 30,900 m^3 of concrete quantities for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years.

The information in Form-3A to be summarized in the table form as shown below.

Summary – Completed contracts of Similar Nature:

Name of Project (Reported on Form-3A)	Country	Name of Contract	Contractor's role (lead partner of JV/Consortium or otherwise)	Contract value in INR	Schedule Completion/actual Completion (month/year)

Date_____ Signature_____

* i) Exchange rate as on date of award of Contract.
ii) Mention exchange rate adopted.

NB : To please attach detailed data sheet wherever possible.

SUMMARY OF FULFILMENT OF TECHNICAL CRITERIA

(To be submitted by the Bidder)

S.No	Qualifying Criteria	Reference (Page No.)
A. General Construction Experience*	The Bidder as Sole Contractor or Partner of a Joint Venture/Consortium or Sub-Contractor approved by the respective employer, should have experience of executing (includes completed and ongoing projects) a Works Contract of value at least INR 72 Crore in the preceding 15 years	
B. Technical Experience	The Bidder as Sole Contractor or as Partner of JV or Sub-contractor approved by the Project Developer, should have executed following works in an ongoing/ completed project during the preceding 20 years. The end date of completion of work should fall within the preceding 20 years reckoned from the last day of the month previous to the one in which NIT is invited. i) Completion of tunnel of minimum 50 m length and 8m finished dia. with Drill and Blast Method. Completion of tunnel means completion of excavation and lining of at least 50 m length and 8m finished dia. Tunnel ii) Open/underground excavation having quantity 1,03,000 m^3 in any single Hydro Electric project.	
Specific Criteria	(a) Experience of executing (includes completed and ongoing projects) at least one civil work involving excavation / earth work of 1,03,000 m^3 or more in a single contract in last 20 years. (b) Experience of achieving progress rate of execution of at least 1,03,000 m^3 excavation / earth work for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years. (c) Experience of executing (includes completed and ongoing projects) at least one civil work involving concrete quantities of 30,900 m^3 or more in a single contract in last 20 years. (d) Experience of achieving progress rate of execution of at least 30,900 m^3 of concrete quantities for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years.	

APPLICATION FORM - 3A **PAGE ___ OF ___ PAGES**

Details of Completed and current Contracts of Similar Nature

Name of Construction Company (Sole Bidder); Partner of a joint venture/Consortium and/or sub-contractor:

Use a separate sheet for each contract.

List all relevant works completed in past, for which the Bidder wishes to qualify.

1.	Name of project	Installed capacity: _____MW
	Country	State/Province
	Name of river	Annual mean discharge of river: Approx. m3/s
2.	Name of employer Contact Person Address	Telephone Fax Email
3.	Name of contract	
4.	Nature of works (Tunnels, excavation / earth work, concreting etc.) and special features (site conditions, remoteness, etc.) relevant to the contract for which the Bidder wishes to qualify:	
5.	Contract role (check one) ( ) Prime contractor ( ) Subcontractor	( ) Lead Partner in a joint venture/consortium ( ) Partner in a joint venture/Consortium
6.	Value of contract *Currency:*	of which, Bidder's share was: %
7.	Time period as per Contract Document (years and months)	Date of award: Date of actual completion:
8.	Works done *(Bidder is to select items to demonstrate qualification):*	
	Completion of tunnel of minimum 50 m length and 8m finished dia. with Drill and Blast Method. Completion of tunnel means completion of excavation and lining of at least 50 m length and 8m finished dia. Tunnel	
	Open/underground excavation having quantity 1,03,000 m^3 in any single Hydro Electric project.	
	Experience of executing (includes completed and ongoing projects) at least one civil work involving excavation / earth work of 1,03,000 m^3 or more in a single contract in last 20 years.	
	Experience of achieving progress rate of execution of at least 1,03,000 m^3 excavation / earth work for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years	
	Experience of executing (includes completed and ongoing projects) at least one civil work involving concrete quantities of 30,900 m^3 or more in a single contract in last 20 years	

	Experience of achieving progress rate of execution of at least 30,900 m^3 of concrete quantities for any continuous period of 12 months (in a completed / ongoing project) in a single contract in last 20 years

Date _____ **Signature** _____

NB : To please attach detailed data sheet wherever possible

General Conditions of Contract (FIDIC), Particular Conditions of Contract and Forms & Procedure

Volume-2, Section - 2, 3, 4

TABLE OF CONTENTS

GENERAL CONDITIONS OF THE CONTRACT

The Conditions of Contract, General Conditions, shall be those stipulated in the "Conditions of Contract for Construction", First Edition 1999, prepared by the ***Federation Internationale des Ingenieurs – Conseils (FIDIC).*** These Conditions are subject to the variations and additions set out hereof entitled "Particular Conditions of the Contract".

Copies of the FIDIC Conditions of Contract (Red Book, first edition 1999) can be obtained from:

FIDIC Secretariat,
P.O. Box 86,
1000 Lausanne 12,
Switzerland
Facsimile: 41 21 653 5432
Telephone: 41 21 653 5003
Website : http://fidic.org/books/construction-contract-1st-ed-1999-red-book

PARTICULAR CONDITIONS OF THE CONTRACT

1 General Provisions	
1.1.1 The Contract	
1.1.1.5	At the end of Sub-Clause 1.1.1.5,insert: The words "Technical Specifications" are synonymous with "Specification".
1.1.1.8	At the end of Sub-Clause 1.1.1.8,insert: The word "Tender" is synonymous with "Bid".
1.1.1.9	At the end of Sub-Clause1.1.1.9,insert: The words "Appendix to Tender" are synonymous with "Appendix to Bid".
1.1.2.9	The sub-clause 1.1.2.9 is deleted and substituted by the following : "Independent Engineer" or "IE" means the person so named in the Contract, or appointed under Sub-Clause 20.2 [Appointment of the Independent Engineer] or Sub-Clause 20.3 [Failure to Agree Independent Engineer] in terms of MOP's OM no. 15-18/2020-HYDEL-II(MoP) dated 27.09.2021 with an objective to reduce the conversion of initial disagreements over issues into full-fledged disputes and for expeditious elimination of disagreements in a just and fair manner.
1.1.4 Money and Payments	
1.1.4.3 Cost	The sub-clause 1.1.4.3 is deleted and substituted by the following: "Cost" means all expenditure reasonably incurred by the Contractor, whether on or off the Site including overhead and similar charges, but does not include any allowance for profit.
1.1.4.8.	At the end of Sub-Clause1.1.4.8., insert: "NPR" or "Nepalese Rupee" means Nepalese Rupees, the lawful currency of Nepal
1.1.5 Works and Goods	
1.1.5.1	At the end of Sub-Clause1.1.5.1, insert: The words "Construction Equipment" or "Equipment" are synonymous with "Contractor's Equipment".
1.1.6 Other Definitions	At the end of Sub-Clause1.1.6, insert: 1.1.6.10 "Milestone" means an intermediate event or landmark identified in the Contract, which is critical for Completion of Works within Time for Completion. Milestone shall not be construed to mean Section of Works. 1.1.6.11 'Subsidiary Company' is one in which the parent/holding

	company holds more than 50% of equity share capital. 1.1.6.12 'Government' or 'GoN' means the Government of Nepal.
1.1.6.8 Unforeseeable	Delete 1.1.6.8 and substitute by the following Unforeseeable" means not reasonably foreseeable physical ground conditions by an experienced contractor. This shall not include conditions other than ground conditions. This shall not include man made conditions*"*
1.2 Interpretation	At the end of Sub-Clause 1.2, add: In these Conditions provisions relating to the expression "Cost plus reasonable profit" for example in GCC Clause 1.9, 2.1, 4.7, 7.4, 8.9, 10.2, 10.3, 11.8, 16.1 the term "reasonable profit" shall be taken as nil and accordingly the words "Cost plus reasonable profit" shall be substituted by the words " Cost "
1.5 Priority of Documents	Delete the documents listed from (a) to (h) in Sub- Clause 1.5 and substitute: (a) the Contract Agreement (if completed), (b) the Letter of Acceptance, (c) the Letter of Tender, d) these Particular Conditions, (e) the General Conditions, (f) the Specifications (including criteria for measurement and payments), (g) the Tender Drawings, (h) the priced Bill of Quantities, (i) the Data Sheets, (j) the Information for Tenderers, (k) any other documents forming part of the Contract.
1.7 Assignment	Delete "the whole or" from 1st line of para (a) of the sub clause.
1.9 Delayed Drawings or Instructions	At the end of first paragraph of Sub-Clause 1.9, insert: The reasonable period between notice and requirement of Drawing(s) shall not be less than 84 days. Para (b) of sub-clause 1.9 is deleted and substituted by the following: "payment of any such Cost, which shall be included in the Contract Price." The words "or profit" in the last line of the sub-clause 1.9 be deleted.
1.12 Confidential Details	At the end of Sub-Clause 1.12, add the following paragraph: The Contractor shall not disclose details of drawings furnished to him and Works on which he is engaged without the prior approval of the Engineer in writing. No photograph of the Works or any part thereof or Equipment employed thereon shall be taken or permitted

	by the Contractor to be taken by any of his employees or any employees of his Subcontractors without the prior approval of the Engineer in writing and no such photographs shall be published or otherwise circulated without the approval of the Engineer in writing.
After Sub-Clause 1.14, add new Sub Clause as below:	
1.15 **Severability**	If any provision or condition of the Contract is prohibited or rendered invalid or unenforceable by Law, such prohibition, invalidity or unenforceability shall not affect the validity or enforceability of any other provisions and conditions of the Contract.
2 The Employer	
2.1 Right of Access to the Site	Para (b) of sub-clause 2.1 is deleted and substituted by the following: "payment of any such Cost, which shall be included in the Contract Price." The word "or profit" in the last line of sub-clause 2.1 be deleted.
3 The Engineer	
3.1 **Engineers Duties and Authority**	Add the word "one of its employees as" after the word "appoint" in the 1st line of 1st para. At the end of Sub-Clause 3.1, Add the following paragraphs: All references to the Engineer acting impartially referred to elsewhere in this Contract is replaced with "The Engineer shall act in accordance with the Contract". Any consultation that the Engineer holds with the Employer in pursuant to the Contract shall be entirely an internal matter between the Engineer and the Employer. The recommendations and determinations by the Engineer are subject to review and finalization by the Employer. The same shall not be subject to matter of reference either by the Contractor or any dispute resolution forum including arbitral tribunal. The Employer shall nominate one of its employees as Engineer. The requirement, in the various Sub-Clauses of GCC and these Conditions of Contract, to consult and/ or to notify the Employer of all the instructions, actions and correspondence of the Engineer with the Contractor is dispensed with. The Engineer shall obtain the specific approval of the Employer before taking action under the-following Sub-Clauses of GCC and these Conditions: (a) consenting to the subletting of any part of the Works under Clause 4.4; (b) Determining an extension of Time for Completion under Clause 8.4; (c) Sub-Clause 4.12: Agreeing or determining an extension of

	Time for Completion and/or additional cost; (d) Sub- Clause 12.3: Evaluation; (e) Sub-Clause 13.1: Instructing a Variation, except; (i) in an emergency situation as determined by the Engineer, or (ii) if such a Variation would increase the Contract Price by less than the percentage specified in the Appendix to Tender. (f) Sub-Clause 13.3: Approving a proposal for Variation submitted by the Contractor in accordance with Sub Clause 13.1 or 13.2. (g) Sub-Clause 13.4: Specifying the amount payable in each of the applicable currencies Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly.
3.4 Replacement of the Engineer	Sub-Clause 3.4 is deleted.
3.5 Determinations	At the end of Sub-Clause 3.5, add: Determination of Cost relating to extension of Time for Completion referred in clause 1.9, 2.1, 4.7, 4.12, 4.24, 7.4, 8.9, 10.3, 11.8, 16.1 & 19 for the purpose of determination referred to in GCC or these conditions “reasonable profit” wherever referred to shall be treated as nil and “Cost” shall be determined as per mechanism provided for in Appendix to Tender. The determinations under this Sub-Clause shall, however, be subject to provisions of Sub-Clause 3.1. The cost claims related to extension of Time for Completion (if admissible) shall be limited to the losses suffered / cost incurred during the hindrances of contemporary period. No claim shall be payable related to consequent effects / cost in extended stay period.

<table>
<tr><td colspan="2">4 The Contractor</td></tr>
<tr><td>4.1 Contractor's General Obligations</td><td>
At the end of second paragraph of Sub-Clause 4.1, add the following paragraphs:

The Contractor shall make his own arrangements for the supply of all Materials, Plant and consumables necessary for the execution of the Works save those materials to be issued by the Employer, as specified elsewhere in the Contract. The Contractor is encouraged to maximize the use of Nepalese material and give first consideration and full and fair opportunity to technically and commercially qualified Nepalese material, provided that use of such Nepalese material meet the quality, quantity and availability requirements and provided further that use of such resources does not have a material and adverse impact on the cost and time of the Works.

Contractor shall ensure availability of adequate quantity of Materials at Site. He shall keep sufficient stock of cement, steel, explosive and P.O.L at Site at any point of time, so that any disruption or delay in availability of these materials shall not affect the progress of Works at Site. Unless otherwise instructed by Engineer, the minimum quantity of such material in stock at Site shall not be less than the quantities as indicated below:
<table>
<tr><th>Material</th><th>Minimum Quantity at site at any point of time</th></tr>
<tr><td>Cement</td><td>Requirement of next one month</td></tr>
<tr><td>Steel</td><td>Requirement of next two months</td></tr>
<tr><td>Explosive materials</td><td>Requirement of next one month</td></tr>
<tr><td>P.O.L.</td><td>Requirement of next one month</td></tr>
</table>
At the end of Sub-Clause 4.1, add:

The Contractor shall submit the completion reports and "as built drawings" for all the works executed by him (whether designed by the Employer or by the Contractor). Two copies of drawings shall be on polyester film of quality to be approved by the Engineer. The Taking-Over Certificate of the Works as per the provisions of Clause 10.1 hereof, shall not be issued by the Engineer in the event of the Contractor's failure to furnish the aforesaid completion reports and "as built drawings" for the Works/Section(s).
</td></tr>
<tr><td>4.2 Performance Security</td><td>
Delete Sub-Clause 4.2 and substitute by the following paragraphs:

The Contractor shall deliver Performance Security to the Employer within 28 days of issue of Letter of Acceptance. The Performance Security shall be in the form of a bank guarantee, as stipulated by the Employer in the Appendix to Tender. The
</td></tr>
</table>

	Performance Security shall be denominated in the types and proportions of currencies in which the Accepted Contract Amount is payable. The Performance Security of a joint venture shall be in the name of individual partner of Joint Venture in proportion of its participation share. The performance bank guarantee for the amounts expressed in Nepalese Rupees shall be issued by A class Bank in Nepal. *The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal.* Without limitation to the provisions of the preceding paragraph, whenever the Engineer determines an addition to the Contract Price as a result of a change in cost and/or legislation or as a result of a variation amounting to more than 25 percent of the portion of the Accepted Contract Amount payable in a specific currency, the Contractor, at the Engineer's written request, shall promptly increase the value of the Performance Security in that currency by an equal percentage. In case of Joint Venture, the value of performance bank guarantee shall be got enhanced by individual partners of JV in the proportion of their participation share. In case, the Contractor is a Subsidiary Company, the parent/holding company will be required to furnish an additional performance bank guarantee of value equivalent to 3% (three percent) of the Accepted Contract Amount or portion of work (where the subsidiary company is Joint Venture Partner) as the case may be in the types and proportions of currencies in which the Accepted Contract Amount is payable, in addition to normal performance bank guarantee to be submitted by the Contractor to the Employer besides entering into a separate Agreement. (in the requisite format included in Bid Document). The Contractor within 180 days of issue of Letter of Acceptance shall provide an additional security for Subcontractor's performance from his Subcontractor, if required, under the Contract. The Performance Security shall be in the form of a bank guarantee, as stipulated by the Employer in the Appendix to Tender. The Performance Security shall be denominated in the types and proportions of currencies in which the Accepted Contract Amount is payable. The performance bank guarantee for the amounts expressed in Nepalese Rupees shall be issued by A-Class Bank in Nepal. *The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal.* The performance bank guarantee (PBG) provided by the Contractor shall be valid upto 90 (Ninety) days beyond Defect Notification Period. The additional performance bank guarantee provided by parent company and/or Subcontractor shall be valid till completion of the part of the Works executed by the Subcontractor.

	All compensation or other sums of money payable by the Contractor to the Employer under the terms of this Contract or any other contract or on any other account whatsoever may be deducted from Performance Security. Also, in the event of the Contractor's Performance Security being reduced by reasons of such deductions, as aforesaid, the Contractor shall, at his own cost, make good the deficit in Performance Security within 14 days of receipt of notice of demand from the Engineer. Should there arise any occasion under the Contract due to which the periods of validities of bank guarantees as may have been furnished by the Contractor from time to time, are required to be extended/renewed, the Contractor shall at his cost get the validity periods of such guarantees extended/renewed, and furnish these to the Engineer one month before the expiry date of the aforesaid Guarantees originally furnished; failing which the existing bank guarantees shall be invoked by the Engineer. Also, in case of any deficit in bank guarantees on any account as might occur or is noticed, the Contractor shall forthwith recoup/replace the same at his cost with acceptable Performance Security.
4.3 **Contractor's Representative**	At the end of Sub-Clause 4.3, add: If Contractor's Representative is not, in the opinion of the Engineer, fluent in English, the Contractor shall have available on site at all times a competent interpreter to ensure the proper transmission of instructions and information. Further, the Contractor shall depute at site the key personnel proposed in the bid and further as agreed under detailed programme. Even after agreeing to the structure of project implementation team including names of key personnel, the Engineer due to nature and exigency of work can direct the Contractor to depute such additional staff as in view of Engineer is necessary and having qualification and experience as approved by the Engineer. The removal of such staff from the site shall only be with the prior written approval of Engineer. The Contractor shall not be paid anything extra whatsoever on account of deployment of additional staff and decision of the Engineer shall be final and binding on the Contractor. The Contractor and all its personnel shall be responsible for the timely and prompt filing of all returns, documents, estimates, accounts, information and details complete and accurate in all respects as may be required under the applicable laws/regulations to the appropriate authorities. In case the Contractor or any of its personnel do not comply with the above requirements, which results in any penalty, interest or other liability, the same shall be borne by and be the liability of the Contractor.

4.4 Subcontractors	Replace Sub-paragraph (a) and (b) as under:- (a) The Contractor shall not be required to obtain consent to suppliers of Materials, or to a subcontract for which the Subcontractor is named in the Contract. Change of already approved Subcontractor shall be allowed with prior consent of the Employer in the following circumstances; (i) dispute between Contractor and Subcontractor; (ii) insolvency of Subcontractor's company. In above circumstances, proposed new Subcontractor shall fulfill, the original Qualifying criterion for that part of work on the basis of which approved Subcontractor was qualified. The new Subcontractor shall also fulfill other conditions regarding Sub-contract mentioned elsewhere in the Contract including Joint Deed of Undertaking and additional Performance Security. In this case, the additional Performance Security shall be submitted within 28 days of award of work to the new Subcontractor by Contractor. (b) Prior consent of the Engineer shall be obtained to other proposed Subcontractors for part of Works provided that, the Subcontractor should have executed a similar work of at least 50% of the value of proposed Sub-let work. Notwithstanding the provisions contained in above, the consent of the Employer shall not be required in respect of the, Sub-contracting or Sub-letting: (i) Provision of labour/ Piece Rate Work (PRW), (ii) For Construction Equipment and Temporary Works, (iii) For clearance and / or transportation, (iv) Road Work, (v) Architectural work. (c) The contractor shall ensure payments to the sub-contractor/labour/ Piece Rate Work (PRW) as per the terms & conditions of the respective agreements etc. In case the progress of 'Works' gets affected on account of delayed/non-payment(s) by contractor, in such cases Employer reserves the right to make payments directly to such sub-contractor/labour/ Piece Rate Work (PRW) on behalf of contractor and recover the same alongwith interest as mentioned under stipulated in Appendix to Tender from the contractor.
4.7 Setting Out	Para (b) of sub-clause 4.7 is deleted and substituted by the following: "payment of any such Cost, which shall be included in the Contract Price."
4.11 Sufficiency of	At the end of Sub-Clause 4.11, add: Items of the works described in the Bill of Quantities for which no

Accepted Contract Amount	rate or price has been entered in the Contract shall be considered (upto the quantities provided in BOQ) as included in other rates and prices in the Contract and will not be paid for separately by the Employer. However, if the executed quantities for such items exceeds BOQ quantity, the rate for the quantities beyond BOQ shall be paid at the rates worked out as per sub-clause 12.3, (Evaluation) not withstanding conditions a(ii) & a(iii) of sub clause 12.3
4.12 Unforeseeable Physical Conditions	Delete the words "and man-made" in the first para.
4.14 Avoidance of Interference	In Sub-Clause 4.14 sub paragraph (b) insert the words "railway and any other right of way" after the words "roads and footpaths". Insert a new sub-paragraph (c) as under: (c) All lights provided by the Contractor shall be screened so as not to interfere with any signal light on the railways or with any traffic or signal lights of any local or other authority. **At the end of Sub – Clause 4.14, add:** Should the Contractor for the purpose of the Contract desire to provide temporary mooring for his craft and floating Goods, he will be allowed to do so in positions and a manner approved by the Engineer at Contractor's cost. The Contractor shall not lay such moorings so as to interfere with traffic in the waterways and such moorings shall be removed if and when required by the Engineer. If any Goods sink from any cause whatsoever, it shall immediately be reported by the Contractor to the competent authorities and the Engineer's Representative, and Contractor shall forthwith, at his cost raise and remove any such Goods or otherwise deal with the same as the Engineer may direct. The fact that such sunken Goods are insured or have been declared a total loss or do not represent any further value shall not absolve the Contractor from his obligations under this Clause to raise and remove the same. Until such sunken Goods have been raised and removed, the Contractor shall set such buoys and display at night such lights and do all such things for the safety as may be required by the competent authorities or by the Engineer's Representative. In the event of the Contractor not carrying out the obligations imposed on him by this Sub-Clause, the Employer may cause to set buoy and display light on or near such Goods at night and raise and remove the same without prejudice to the right of the Employer to hold the Contractor liable and all expenses and consequences thereon and incidental thereto shall be borne by the

	Contractor and shall be recoverable from him as a debt by the Employer or may be deducted by the Employer from any moneys due or which may become due to the Contractor.
4.16 **Transport of Goods**	At the end of Sub-Clause 4.16, add: If it is found necessary for the Contractor to move one or more loads of Goods over roads, highways, bridges on which such oversized and overweight items are not normally allowed to be moved, the Contractor shall obtain prior permission from the concerned authorities. Payments for complying with the requirements, if any, for protection of or strengthening of the roads, highways or bridges shall be made by the Contractor and such expenses shall be deemed to be included in the Contract Price. Further, the Contractor shall comply with applicable laws in this regard. The Contractor shall use only registered common carriers for transport of goods.
4.17 **Contractor's Equipment**	At the end of the Sub Clause 4.17, add: If in the opinion of Engineer, the Equipment deployed by the Contractor are old/inapt for carrying out the Works and the Works are likely to be delayed due to deployment of such Equipment, the Engineer can ask the Contractor to replace such Equipment. Also, based on the nature and exigency of work, Engineer can direct the Contractor to depute such additional Equipment as is deemed necessary for timely completion of Works without anything extra whatsoever on account of replacement of old Equipment and/or deployment of additional Equipment.
4.18 **Protection of the Environment**	At the end of Sub-Clause 4.18, add: The Contractor shall be required to ensure that there shall be no felling of trees by him or his labourers or their family members and he will be solely responsible for their acts in this regard. The Contractor shall try to maintain ecological balance by preventing deforestation, water pollution and defacing of natural landscape in the vicinity of work areas. The Contractor shall so conduct his construction operations as to prevent an unnecessary destruction of, scarring or defacing the natural surroundings in the vicinity of the work area. In order to maintain the ecological balance, the Contractor shall specifically observe the following instructions: a) Where unnecessary destruction, scarring, damage or defacing may occur as a result of the Contractor's operation, the same shall be repaired, replanted or otherwise corrected at the Contractor's expense. The Contractor will prevent scattering of rocks and other debris outside the work areas. All work areas shall be smoothed and graded in a manner to conform to the natural appearance of the landscape as directed by the

	Engineer. b) All trees and shrubs which are not specifically required to be cleared or removed for construction purposes shall be preserved and protected from any damage that may be caused by the Contractor's construction operation and Equipment. The removal of trees or shrubs will be permitted only after prior approval by the Engineer. Special care shall be exercised where trees or shrubs are exposed to injuries by Construction Equipment, blasting, excavating, dumping, chemical damage or other operation and the Contractor shall adequately protect such trees by use of protective barriers or other methods approved by the Engineer. Trees shall not be used for anchorage. c) The Contractor's construction activities shall be performed by methods that will prevent entrance or accidental spillage of solid matter contaminants, debris and other objectionable pollutants and wastage into the river. Pollutants and wastes shall be disposed of in a manner and at sites approved by the Engineer. The Contractor shall fully comply with Environment Rules and Regulations as applicable in Nepal. d) In the conduct of construction activities and operation of Construction Equipment, the Contractor shall utilize such practicable methods and devices as are reasonably available to control, prevent and otherwise minimize air pollution. The Contractor shall fully comply with Environment Protection Act, 2053 (1997 A.D.), Nepal. e) Burning of materials resulting from clearing of tree, bush, combustible construction materials and rubbish may be permitted only when atmospheric conditions for burning are considered favorable. f) Contractor (including its Subcontractor) shall provide alternative fuel arrangement i.e. cooking gas/ kerosene oil, electricity free of cost to all its canteen /mess, labourers and staff working in the Project during the whole period of construction activity to avoid felling of trees for use as firewood. In case alternative fuels supply i.e. kerosene, gas, electricity is not available in the project area, the Contractor shall approach the Forest Department, GoN to open fuel depot in the project area for meeting the demand of fuel wood. g) No wood shall be used for scaffolding, shuttering or centering in the construction of Works. h) Wood, if required, shall have to be purchased from the Forest

	Department, GoN. i) The Contractor shall be required to prevent flowing of debris and muck in to the river. Necessary retaining structures like walls/crates etc shall be constructed for the purpose. The Contractor shall also stabilize the muck fully i.e. consolidation and compaction of the muck shall be carried out in the muck dump sites before handing it over to the Employer at the end of construction period. j) Medical facilities as well the recreational facilities shall also be provided to the labourers. k) All labourers to be engaged for the construction work shall be thoroughly examined by health personnel and adequately treated before they are deployed in the work. l) Contractor shall employ maximum number of local people in not only un-skilled category but also in semi-skilled and skilled categories by imparting skills through training to selected locals. Detailed plan regarding this should be submitted by the Contractor within two months from the Commencement Date. m) All the Construction Equipment which are likely to generate high noise levels are to be fully equipped (with noise reduction measures) to meet the ambient noise control standards. n) The Employer shall facilitate/assist Contractors in obtaining necessary permits from District Authorities. The Contractor shall not allow any of its employee / labourers employed by it to settle in that area even temporarily. If any provision(s) is not complied with, within a reasonable time even after issue of a notice in this respect, the necessary operations would be carried out by the Engineer at the cost of the Contractor. Separate payment shall not be admissible to the Contractor for complying with the provisions of this clause except the protection works as specially provided for in BOQ. All other costs shall be deemed to have been included in the items mentioned in the Bill of Quantities. The Contractor shall indemnify and hold the Employer harmless against and from all claims, damages, losses and expenses (including legal fees and expenses) resulting from the consequences of any failure by the Contractor to comply with the

	provisions of this Sub-Clause.
4.19 **Electricity, Water and Gas**	At the end of Sub-Clause 4.19, add: The Contractor shall make all arrangements for the full anticipated requirement of construction power through relevant authorities or by installing diesel generating sets. No additional cost on account of this shall be paid to contractor. The Contractor shall bid his prices considering the above. Permission from Government authorities, if required, for above construction power and operation thereof shall be arranged by the Contractor at his own cost.
4.21 **Progress Reports.**	In sub-para 4.21 (a), the words "and including these.....Nominated Subcontractors])" are deleted. At the end of Sub-Clause 4.21, insert the following paragraph: (i) List of all insurance claims lodged with the insurance companies showing details viz nature and amount of claim lodged, status of settlement, reasons for delay in settlement of claim(s) (if any), amount settled and paid by insurance company, amount of settled claim paid or to be paid to the Employer (where Employer has interest in the claim) etc. (j) The Contractor/Engineer is required to maintain Hindrance Register(s) (Section-4, Forms and Procedures) for reporting hindrances if any, while executing the work in respect of design, engineering, procurement, supply and site work related issues. The Contractor/Engineer shall record hindrances in the Hindrance Register(s) and Contractor shall bring each hindrance to the notice of Engineer not later than 7 days of the happening of the hindrance failing which the same shall not be considered or taken into account for any purpose whatsoever. The Contractor shall submit in the monthly progress report upto date hindrance record in the format as mentioned in the hindrance register. (k) In case of any hindrance, if the Contractor's resources are idle, the Contractor shall get the same verified from the Engineer on regular basis. Up to date duly verified idling of man power and Equipment shall be submitted by the Contractor in the format included in Section-4, Forms & Procedures or as approved by the Engineer. The Contractor shall submit the above details along with reasons for such idling. If due to any reason the details could not be got verified, the Contractor shall submit the same to the Engineer and shall provide all assistance to the Engineer for verification of the same. (l) Date wise receipt of the major construction materials such as steel, cement, explosives stock position and consumption during

	the month. (m) List of all the claims submitted by the Contractor. (n) List of the Construction Equipment brought at Site during the period with purchase invoices. (o) The Contractor shall submit annual report regarding the status of works undertaken in pursuance to the contract. In addition to other annual reports namely gist of progress during the year; photograph showing status of works at the end of the accounting year; details of the Contractor's Personnel and Equipment; details of claims preferred; safety statistics including hazardous accidents; main environment aspects; the Contractor shall also submit report on annual accounts of the works undertaken by the Contractor under the Contract as a separate accounting unit. The annual accounts shall be compiled in accordance with applicable accounting standards, as well as audited by their statutory auditors/independent Chartered Accountant. The Contractor shall submit the audited annual accounts within 60 days from the end of accounting year. (p) Requirement of drawings for next 6 months, structure wise deployment status of Equipment/ manpower etc.
	Add new Sub Clauses as below:
4.25 **Land**	Land for Infrastructure shall be arranged by the Contractor himself at his own cost except for that specified elsewhere in the Contract to be made available by Employer. Accordingly, the Contractor shall be responsible for arranging land for his installation facilities/job facilities viz. labour camp, batching plant, crushing plant, infrastructural facilities etc. for use by the Contractor, as above. The Employer shall arrange land for Permanent Works, dumping area and quarries, free of cost to the Contractor. The use or occupation of the land by the Contractor shall not confer on him any right of tenancy or possession thereof. The Contractor shall vacate immediately land upon one month notice of the Engineer.
4.26 **Explosive Magazine**	The Contractor shall arrange explosives and their license(s) for all requirements of explosive required for the completion of works at his own cost. The contractor shall also construct explosive magazine at his own cost as per design approved by Nepal Army/ Employer. The contractor shall also construct residential accommodation/ barrack for Army Security personnel at his own cost as per design/drawing by Nepal Army / Employer. The contractor shall procure explosives either from Nepal Army or import the same from India. The Contractor shall comply with all

	relevant laws, ordinances, instructions, regulations issued by Government from time to time regarding the purchase, import, handling, transportation, storage, safety, security, use and management of Explosives. Further, as per norms of GoN, the security arrangements for explosives during transportation within Nepal, storage and use etc. shall be provided by Nepal Army & any type of cost which is incurred during transportation, storage and uses of explosive shall be borne by the contractor. The cost for Explosive arrangement includes any expenditure incurred either to comply with all relevant laws, ordinances, instructions, regulations issued by Government from time to time regarding the purchase, import, handling, transportation, storage, safety, security, use and management of Explosives or due to any MOU/agreement signed between Employer, Contractor & Nepal Army for explosive management. The contractor shall also be responsible for housekeeping of the residential accommodation/barracks and shall make necessary arrangements for boarding, lodging, kitchen utensils, arrangement of electricity etc. and transportation of army personnel, APF, Nepal Police in line with any MOU/agreement signed between Employer, Contractor & Nepal Army at his own cost. The bid prices shall be deemed to be inclusive of all costs regarding procurement, usage, transportation and all the other expenses associated with handling of explosives like coordination with local administration, Nepal Army, APF, Nepal Police etc.
5 Nominated Subcontractor	
	Clause 5 is not Applicable.
6 Staff And Labour	
6.1 **Engagement of Staff and Labour**	At the end of Sub-Clause 6.1, add: The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour with appropriate qualifications and experience from the Nepal. Unskilled labour shall, in principle, be recruited from the region of the project.
6.3 **Persons in Service of Employer**	At the end of Sub-Clause 6.3, add: and personnel of other contractors working at the project.
6.4 **Labour Laws**	Delete Sub-Clause 6.4 and substitute: During continuance of the Contract, the Contractor and his Subcontractor(s) shall abide at all times by all existing labour enactments and rules made there under, regulations, notifications and bye laws of GoN or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by GoN or the local authority. The Contractor shall also comply with

	the Laws relating to their employment, health, safety, welfare, immigration, and shall allow them all their legal rights. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention by the Contractor of any of the provisions of any Act or rules made thereunder, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/acts/rules/regulations including amendments, if any, on the part of the Contractor, the Employer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer. The employees of the Contractor and his Subcontractor in no case shall be treated as the employees of the Employer at any point of time. Salient features of some of the major labour laws that are applicable to construction industry including amendments (if any) thereto are given below. Applicable laws of Nepal: a. Labour Act, 1991 (2048) b. Human Right Commission Act, 1997 (2053) c. Contract Act, 2000 (2056) d. Trade Union Act (2049) e. Labour and employment policy (2062) f. Beema Act (2049) g. Bonus Act (2030) h. Labour Regulation, 2050 The above Labour laws/Acts applicable in Nepal are indicative and Contractor shall comply with all the concerned laws/Acts applicable in Nepal for execution of works under the Contract. Provided always that the Contractor shall have no right to demand payments/claims whatsoever on account of his compliance with his obligations under this clause and Labour Regulation except those specifically mentioned in Sub-Clause 13.8. The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.
6.5 **Working Hours**	Delete Sub-clause 6.5 and substitute: Subject to any provision to the contrary contained in the Contract, the Contractor shall have the option to work continuously by day and by night and on locally recognized holidays or days of rest, without any additional cost to the Employer.
6.7 **Health and Safety**	At the end of Sub-Clause 6.7, add: The Contractor shall provide and maintain upon the works sufficient, proper and efficient life-saving appliances and first-aid

	equipment to the approval of the Engineer and in accordance with the requirements of ILO Convention No. 62. The appliances and equipment shall be available for use at all time.
7 Plant, Materials and Workmanship	
7.4 Testing	Para (b) of sub-clause 7.4 is deleted and substituted by the following: "payment of any such Cost, which shall be included in the Contract Price."
7.5 Rejection	At the end of Sub-Clause 7.5, add: "All the Works during the progress and after completion *till defect liability period* shall be subjected to technical examination by any independent authority. If any defect of material or workmanship found during technical examination then compensation there of shall be recovered from the Contractor even if it has been accepted by the Engineer."
7.7 Ownership of Plants and Materials	Delete sub para (a) of Sub-Clause7.7 and substitute by the following: (a) when it is incorporated in Works;
7.8 Royalties	Delete Sub-Clause7.8 and substitute: The Contractor shall pay all royalties, rents and other payments for: (a) natural Materials used, and (b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract. The royalty, rents and other payment for the material quarried shall be paid directly to the concerned authorities by the Contractor and the same shall be reimbursed on submission of documentary evidence. The Contractor shall be responsible for the reconciliation of the quantities of materials on which royalty is payable and settlement of the total amount of royalty charges to be paid, with the concerned authorities and any payment due to be paid to them arising out of such reconciliation and settlement shall also be paid by the Contractor, which will also be reimbursed on submission of documentary evidence of same. For the payment of royalties concerned authorities shall be of Govt. of Nepal.
8 Commencement, Delays and Suspension	
8.1 Commencement of Works	Delete first paragraph of Sub-Clause 8.1 and substitute: The Commencement Date shall be date of issue of the Letter of Acceptance by the Employer.

8.3 Programme	After first sentence of Sub-Clause 8.3, add the following: Submittal and approval of detailed programme is a condition precedent to the release of first Interim Payment Certificate. Sub-para 8.3 (b) is deleted.
8.4 Extension of Time for Completion	Add the following at the end of the clause: Contractor shall submit application for extension of time with supporting documents within 28 *days* at the end of the each quarter failing which it would be construed that there was no hindrance (even though the hindrance has been brought to the notice of Engineer as per Clause 4.21) during the quarter requiring extension of Time for Completion and Contractor shall forfeit his claim for extension of Time for Completion. In case, hindrances brought to the notice of Engineer as above, contain any hindrances resulting from interface activities with other agencies working at the project, as listed in "Appendix to Tender", the Employer shall determine the same as per the durations of such interface activities specified in "Appendix to Tender".
8.7 **Delay Damages**	At the end of first paragraph of Sub-Clause 8.7, add: Delay Damages shall be recoverable for delay in achievement of Interdependent Contract Milestones, if any, at the rate stated in Appendix to Tender. If Works as a whole are completed within specified Time for Completion then the Delay Damages recoverable for Intermediate Contract Milestones shall be refunded/waived off.
10 Employers Taking Over	
10.2 Taking Over of Parts of the Works	Last but one para "If the Contractor incurs Cost..... agree or determine this Cost and profit" of sub-clause 10.2 be deleted and substituted by the following: "If the Contractor incurs Cost as a result of the Employer Taking Over and / or using a part of the Works, other than such use as is specified in the Contract or agreed by the Contractor, the Contractor shall (i) give notice to the Engineer and (ii) be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to payment of any such Cost which shall be included in the Contract Price. After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this Cost."
10.3 Interference with Tests on Completion	Para (b) of sub-clause 10.3 is deleted and substituted by the following:

	"payment of any such Cost , which shall be included in the Contract Price."
11 Defects Liability	
11.8 Contractor to Search	The words " the Cost of the search plus reasonable profit shall be agreed" in third and fourth line of sub-clause 11.8 is deleted and substituted by the following : " the Cost of the search shall be agreed"
12 Measurement and Evaluation	
12.3 Evaluation	In the Sub-Clause 12.3 substitute Sub-Para(a) with the following: (a) (i) this item is not specified in the Contract as a "fixed rate item" (ii) this variation in quantity (over and above BOQ quantity) multiplied by such specified (*BOQ*) rate for this item exceeds 0.25% of the Accepted Contract Amount, and (iii) the measured quantity of the item varies by more than 25% from the quantity of this item in the Bill of Quantities or other Schedule, Delete the last two paragraphs "*Each new rate……relevant matters"* & *"Until such time----------Interim Payment Certificates* of Sub-Clause 12.3 and substitute: The rates already provided in the Bill of Quantities, shall apply in respect of the same item(s) of work to be executed due to Variation, in respect of quantities of individual items appearing in the Bill of Quantities. In case of items for which rates are not available in the Bill of Quantities, the rates of such items as far as practicable shall be derived from the rates of analogous item(s) in the Bill of Quantities after submission of details by the Contractor on actual observance at Site. The decision to select analogous item(s) shall be taken by the Engineer, which shall be conclusive and binding on the Contractor. In the cases, where analogous items are not available in the Bill of Quantities, such items shall be termed as extra item and the rates for such items and also for items exceeding the prescribed limits as mentioned in Sub Para (a) above due to increase in quantity(ies), the Contractor, within 15 days (or as agreed by the Engineer) from the receipt of order to execute such items shall submit rate analysis to the Engineer supported by documentary evidence of basic rates adopted therein, notwithstanding the fact that the rates for such items exist in the Contract; having regard to the cost of Materials, actual wages of

	labour and ownership & operational cost of Construction Equipment required as per standard norms or if standard norms are not specified/available then on the basis of labour/Materials/Construction Equipment actually engaged for the particular work. The standard norms for including indirect charges for labour and Materials specified herein shall mean as those specified in "Guidelines for preparation of Project Estimates for River Valley Projects (latest version)" of Central Water Commission, Govt. of India, and if not available therein, then those of State's Public Works Department/District Rates or DoR, GoN. Standard norms for Construction Equipment use shall mean those of Bureau of Indian Standards (IS : 11590 : 1995 – latest version) and if not available therein, then those specified in "Guidelines for preparation of Project Estimates for River Valley Projects (latest version)" of Central Water Commission, Govt. of India. Over and above the cost of labour, Materials arranged by the Contractor and ownership & operational cost of Construction Equipment, an element of 20% shall be allowed to cover the Contractor's overheads, profits, and supervision charges. However, for materials issued by the Employer to the Contractor and/or Construction Equipment supplied on rental charge(s) by Employer to the Contractor during the course of execution of Works, the Contractor shall be entitled to only 10% (ten percent) of such costs to cover local transportation/handling, overheads, supervision, profits etc. The new rate derived as above shall be payable only for the executed quantities in excess of 125% (one hundred twenty five percent) of BOQ quantities as worked out after meeting conditions (ii) and (iii) at para (a) above. For items exceeding the prescribed limits as mentioned in sub para (a) above due to decrease in quantity (ies), amount shall be derived by multiplying (BOQ rate plus applicable escalation on the date of completion of whole of the work) by the quantity in excess of prescribed limit minus variable cost admissible for the quantities decreasing in excess of 25% of the BOQ. **Illustration:** Prescribed limit 25% Quantities executed 70% Amount admissible = {5% of quantity x (BOQ rate + applicable escalation on the date of completion of whole of the work)} minus variable cost for the 5% of BOQ quantity. The compensation for negative deviations shall not be applicable if

	the item has been substituted. At the end of sub-clause 12.3 add the following: "Provided always that upon completion of Works if the Contract Price is lower than the Accepted Contract Amount, then the Contractor shall not be entitled for any cost compensation other than that resulting from Variations viz. rates for increase/decrease in BOQ quantities and new/extra items worked out as per above mechanism." For the purpose of this clause, items of *'Cement variation and Dewatering'* shall be considered as *'fixed rate items'.*
12.4 **Omissions**	Sub-Clause 12.4 is Not Applicable
13 Variations And Adjustments	
13.2 **Value Engineering**	Sub-Clause 13.2 is Not Applicable
13.3 Variation Procedure	The 1st para of the sub-clause 13.3 is replaced with the following para: "If the Engineer requests a proposal, prior to instructing a variation, the Contractor shall respond in writing within 14 days or in a period agreed by the Engineer and shall submit:" In the 2nd para starting with "The Engineer shall----------", shall be replaced with the following text: "The Engineer shall, as soon as practicable after receiving such proposal, respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response."
13.5 **Provisional Sums**	Sub-Clause 13.5 is Not applicable
13.6 **Daywork**	Sub-Clause 13.6 is Not applicable:
13.7 **Adjustments for Changes in Legislation**	Delete sub paragraph (b) of Sub-Clause 13.7 and substitute : (b) payment or deduction of any such cost which shall be adjusted in the Contract Price . At the end of Sub-Clause 13.7, add: Notwithstanding the foregoing, such additional or reduced cost shall not be separately paid or credited if the same shall already have taken into account in the indexing or any inputs to the Price Adjustment Formulae in accordance with the provisions of Sub Clauses 13.8. Provided that in the event of variation in the rates of

	royalty charges/fresh levy of royalty on materials, the payment shall be regulated in accordance with Sub-clause 7.8 of Particular Conditions (royalties). Provided always that any variations resulted from the changes in legislation on the labour and staff of the Contractor, shall be deemed to be included in the Adjustment for Changes in Cost (price adjustment formula) included in sub-clause 13.8 hereof and shall not be paid separately by the Employer under this sub-clause 13.7.
13.8 **Adjustments for Changes in Cost**	Delete Sub-Clause 13.8 and substitute with following: The amounts payable to the Contractor shall be adjusted for rise or fall in the cost of labour, Goods and other inputs to the Works, by the addition or deduction of the amounts determined by the formulae prescribed in this Sub-Clause. To the extent that full compensation for any rise or fall in Costs is not covered by the provisions of this or other Clauses, the BOQ unit rates shall be deemed to have included amounts to cover the contingency of other rises and falls in costs. Subject to the conditions laid down hereunder, BOQ unit rates are subject to price adjustment in accordance with the Price Adjustment formulae incorporated in this clause. Adjustment of payments shall be applicable only for the works, which are carried out within the Time for Completion. However, if the Contractor fails to complete whole of the Works within the Time for Completion prescribed under Clause 8.2, adjustment of prices thereafter until the date of completion of the Works shall be made using either (i) the indices or prices applicable on the date 49 days prior to the expiry of the Time for Completion, or (ii) the current indices or prices; whichever is more favourable to the Employer. Payment to Contractor for work done shall be adjusted for increase or decrease in the cost of labour, materials and petrol, diesel, oil and lubricants (POL) and other inputs according to the procedure mentioned hereafter. The adjustment to the Interim Payment Certificates in respect of changes in cost and legislation shall be determined from the following formulae. The Price Adjustment formula for the various components of the Contract Price shall be construed as stipulated hereinafter. The formula designed for governing and calculating the Price Adjustment to be applied shall be as follows: **Category – I : For all items of structural steel supports, steel ribs, steel lagging and metal Works (steel) including steel pipes.**

$$CC_I = CC_0\left\{F + s\times\frac{S_1}{S_0} + l\times\frac{L_1}{L_0} + b\times\frac{B_1}{B_0} + e\times\frac{E_1}{E_0} + m\times\frac{M_1}{M_0} + u\times\frac{U_1}{U_0} + p\times\frac{P_1}{P_0} + d\times\frac{D_1}{D_0}\right\}$$

Category – II: For all items of reinforcement steel, rock bolts, rock anchors and wire mesh etc.

$$CC_{II} = CC_0\left\{F + s\times\frac{S_1}{S_0} + l\times\frac{L_1}{L_0} + m\times\frac{M_1}{M_0} + u\times\frac{U_1}{U_0} + p\times\frac{P_1}{P_0} + d\times\frac{D_1}{D_0}\right\}$$

Category–III: For all items of concrete, shotcrete, masonry, cement grouting and cement variation etc.

$$CC_{III} = CC_0\left\{F + c\times\frac{C_1}{C_0} + l\times\frac{L_1}{L_0} + d\times\frac{D_1}{D_0} + m\times\frac{M_1}{M_0} + u\times\frac{U_1}{U_0} + p\times\frac{P_1}{P_0}\right\}$$

Category – IV: For excavation items

$$CC_{IV} = CC_0\left\{F + p\times\frac{P_1}{P_0} + l\times\frac{L_1}{L_0} + d\times\frac{D_1}{D_0} + m\times\frac{M_1}{M_0} + u\times\frac{U_1}{U_0}\right\}$$

Category-V: For all the balance items not included in Category-I, II, III & IV above.

$$CC_V = CC_0\left\{F + l\times\frac{L_1}{L_0} + d\times\frac{D_1}{D_0} + m\times\frac{M_1}{M_0} + u\times\frac{U_1}{U_0} + p\times\frac{P_1}{P_0}\right\}$$

Where

CC_I, **CC_{II}**, **CC_{III}**, **CC_{IV} and CC_V**= Adjusted gross value of work done month-wise for items listed under **Category-I, Category-II**, **Category-III**, **Category-IV** and **Category-V** respectively.

CC_0= Gross value of work done month-wise for items listed under Category-I, Category-II, Category-III, Category-IV and Category-V respectively.

'F' = *Fixed portion of the gross value which will not be subjected to any adjustment.*

's' = Coefficient weightage of steel content in the cost of work.

'l' = Coefficient weightage of labour (for skilled categories) content in the cost of work

'b' = Coefficient weightage of oxygen gas content in the cost of work

'e' = Coefficient weightage of electrodes content in the cost of work

`m'= Coefficient weightage of other materials content in the cost of

	work. 'u' = Coefficient weightage of other labour content in the cost of work 'c' = Coefficient weightage of cement content in the cost of work. 'd' = Coefficient weightage of High Speed Diesel Oil content in the cost of work 'p' = Coefficient weightage of Construction Equipment (Machinery & Machine Tool) 'S' = Index for Steel (Mild Steel -Long Products) Index Numbers of Wholesale prices in India - by Groups & Sub-Groups (Base: 2011-12=100) Published by Office of Economic Advisor, Ministry of Industry/ Govt. of India under the head 'N- MANUFACTURE OF BASIC METALS' and Sub- head '(d) Mild Steel -Long Products'. 'L' = Labour Index *National salary & wage index for construction labours (Base: 2011-12 = 100) issued by Nepal Rastra Bank.* 'B' = Index for Oxygen Gas (Manufacture of basic chemicals) Index Numbers of Wholesale Prices in India - by Groups & Sub-Groups (Base: 2011-12=100) Published by Office of Economic Advisor, Ministry of Industry/ Govt. of India under the head 'J- MANUFACTURE OF CHEMICALS AND CHEMICAL PRODUCTS' and sub-head '(a) Manufacture of basic chemicals' 'E' = Index for Electrodes (Manufacture of Fabricated Metal Products, Except Machinery and Equipment) Index Numbers of Wholesale Prices in India - by Groups & Sub-Groups (Base: 2011-12=100) Published by Office of Economic Advisor, Ministry of Industry/ Govt. of India under the head 'O- MANUFACTURE OF FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT' M' = Index for Material (all commodities) Index Numbers of Wholesale Prices in India - by Groups & Sub-Groups (Base: 2011-12=100) Published by Office of Economic Advisor, Ministry of Industry/ Govt. of India Under the Head 'All Commodities'. 'U'= Rate of Minimum wage applicable for unskilled labour notified by the Govt. of Nepal, as amended from time to time.

	'C' = Index for Cement (Manufacture of cement, lime and plaster) Index Numbers of Wholesale Prices in India - by Groups & Sub-Groups (Base: 2011-12=100) Published by Office of Economic Advisor, Ministry of Industry/ Govt. of India under the head 'M- MANUFACTURE OF OTHER NON-METALLIC MINERAL PRODUCTS' and sub-head '(e) Manufacture of cement, lime and plaster'. 'D' = High Speed Diesel Oil High Speed Diesel Oil all *taxes, duties etc.* inclusive monthly weighted average Price for bulk supply at Biratnagar/Itahari 'P'= Index for Machinery and Machine tools (Manufacture of Machinery and Equipment) Index Numbers of Wholesale Prices in India - by Groups & Sub-Groups (Base: 2011-12=100) published by Office of Economic Adviser, Ministry of Industry, Govt. of India under the head 'R- MANUFACTURE OF MACHINERY AND EQUIPMENT'. **Sub-Script for all Categories (*I, II, III, IV & V)*:** '0' = Refers to index / price as on 28 days prior to last date for submission of price bids. In case of High Speed Diesel all inclusive official price for bulk supply of Diesel at the place mentioned in Appendix to Tender applicable on 28th day before the last date of submission of price bids. "1" = Refers to index / price as applicable for the month prior to the month in which the work is executed for which adjustment is applicable. If at any time the current indices are not available, provisional indices as determined by the Engineer, will be used subject to subsequent correction of the amounts paid to the Contractor when the current indices become available. The weightings shall be those listed in Annexure-III to Appendix to Tender. The base cost indices or prices shall be those prevailing on Base Date. Current indices or prices for 'all Commodities (cost elements)' shall be those prevailing one month prior to the last day of the period and Current indices or prices for 'Labour (cost element)' shall be the month under consideration, to which a particular Interim Payment Certificate is related. If at any time the current indices are not available, provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available. In case, government or other applicable agency, stops publishing any of the price indices at any time and announces a new series with a

	linking factor then new series shall be used with new linking factor and old series with linking factor shall not prevail. However, if the new series released by the relevant source does not have the Linking Factor the new series shall be used without use of Linking Factor and current as well as base indices of new series shall be used from the date, indices of old series becomes unavailable. Variations arising on account of payment related to rates for varied works (extra, altered and substituted items) whose cost has been worked out on actual analyzed cost or on market price basis as envisaged in Sub-Clause 12.3 shall be regulated with reference to such variations in cost as are subsequent to the date of settlement of the rates, instead of the date of submission of Price Bids. *The price adjustment formulae will be applied on gross value of work done for a particular month (CC_0) after making any deductions pursuant to sub-clause 4.19."*
14 Contract Price and Payment	
14.1 **The Contract Price**	After subparagraph (d) in Sub-Clause 14.1, add the following: (e) Subject to paragraph (b) in sub-clause 14.1 of GCC, all applicable taxes/duties including VAT as applicable and assessed on the Employer shall also be included in the price/rates, which shall be deducted from the Interim bills and 25% of same shall be directly deposited by the Employer with Tax Authorities and balance retained 75% will be released after submission of documentary evidence by the contractor.
14.2 **Advance Payment**	Delete Sub-Clause 14.2 and substitute: (a) The Engineer will make upon the request of the Contractor, an interest bearing advance payment to the Contractor exclusively for the costs of mobilization in respect of the Works in an amount not exceeding 10 (Ten) percent of the Accepted Contract Amount. The Contractor shall submit details of complete & satisfactory utilization of cost of mobilization to the following effect: i. construction of colonies, stores and workshops etc., ii. mobilization of labour, equipment etc., iii. overhauling, dismantling and transportation of Contractor's Equipment to the Site as per agreed schedule including procurement of spare parts, iv. construction of enabling works such as development of land for infrastructure works and foundation for Constructional Equipment etc. The Contractor shall provide details of utilization also for verification of the Engineer. The advance shall bear a simple interest at the rate stipulated in

	Appendix to Tender. In case of mis-utilization of the advance by the Contractor is observed by the Engineer, the advance to the extent mis-utilized shall be immediately recovered from or paid by the Contractor alongwith interest accrued. Payment of such advance amount will be due under separate certification by the Engineer after (i) provision by the Contractor of the performance security in accordance with clause 4.2, (ii) signing of the Contract by the Parties and (iii) provision by the Contractor of an unconditional Bank Guarantee in a prescribed form and by a Bank acceptable to the Employer in amounts equal to 110% of the advance payment requested for. Bank Guarantees for the amounts expressed in Nepalese Rupees shall be issued by any A Class Bank in Nepal. The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India (to be confirmed by their Branch in Nepal or by any A Class Bank in Nepal). Such Bank Guarantee shall remain effective until the advance payment alongwith interest has been fully repaid, but its amount thereof may be progressively reduced by the amount repaid by the Contractor as indicated in Interim Payment Certificate(s). The release of advance payment shall be subject to receipt of original Bank Guarantee directly from the issuing bank in the manner & term as stipulated in these Conditions of Contract to the Employer and which is in finality to be acceptable to the Engineer. (b) The interest as specified in 14.2 (a) shall be charged on monthly rest basis reckoned from the date of release thereof. (c) The advance payments under 14.2 (a) above plus interest accrued thereupon shall be recovered through pro-rata deductions from the Interim Payment certified by Engineer as follows : (i) The recovery of principal alongwith interest shall commence in the third Interim Payment Certificate and shall be recovered on pro-rata basis of advance released from the gross payment of all Interim Payment Certificates until such time as the advance payment has been repaid. Always provided that the advance payment shall be completely repaid till completion of works. The gross payment shall mean and include the payment towards scheduled items, extra items, deviated items, along with substituted items including price adjustments for the purpose of this Sub Clause only. (ii) The interest shall be calculated on the outstanding amount of principal at the close of each month. The interest as may be due on 1st day of each month will be recovered from the Interim Payment Certificates of the Contractor to be paid during that month. If for

	any reason, the payment due is insufficient to recover the full interest and principal together, interest shall be credited/recovered first and the residual applied to the principal. However, in case, full interest itself cannot be recovered, the balance amount of unrecovered interest shall also carry the same interest rate as specified in 14.2 (a) above till the full amount is recovered. The Contractor shall always have the option to limit the drawl of advance to the extent desired and to have the recoveries commenced and/or completed earlier and/or have recoveries effected in installments of higher amounts and also to repay part or whole of the advance by direct payment rather than through Interim payment certificates. (d) Should there arise any occasion under the Contract due to which the periods of validities of Bank Guarantees as may have been furnished by the Contractor from time to time, are required to be extended/renewed, the Contractor shall at his cost get the validity periods of such guarantees extended/renewed, and furnish these to the Engineer one month before the expiry date of the aforesaid Guarantees originally furnished; failing which the existing Bank Guarantees shall be invoked by the Engineer. (e) If the advance payment has not been repaid prior to the issue of the Taking-Over Certificate for the Works or prior to termination under Clause 15 [Termination by Employer], Clause 16 [Suspension and Termination by Contractor] or Clause 19 [Force Majeure] (as the case may be), the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Employer. (f) The advance under (a) above may be released at any time before 3rd IPC subject to fulfillment of the above stipulated conditions and further provided that the Engineer is fully satisfied that the advance payments so released along with interest shall be completely recovered prior to the completion of works.
14.5 **Plant and Materials intended for the Works.**	At the end of Sub-Clause 14.5, add: The Contractor shall sign an indenture in the form (Annexure-V) to be specified by the Engineer for release of any payment under this Sub-Clause. The contractor shall ensure payments to the suppliers as per the terms & conditions of the respective purchase orders/agreements etc. In case the progress of 'Works' gets affected on account of delayed/non-payment(s) by contractor, in such cases Employer reserves the right to make payments directly to such suppliers on behalf of contractor and recover the same alongwith interest as mentioned under stipulated in Appendix to Tender from the contractor.

14.6 Issue of Interim Payment Certificates	At the end of first sentence of Sub-Clause 14.6, add: "and the Contractor has submitted his Permanent Account Number issued by the Income Tax Authority of Nepal, the proof of payment of insurance premia as per the requirement of the Contract."
14.7 Payment	Delete sub paragraph (b) of Sub –Clause 14.7 and substitute: (b) (i) Based on the statement and supporting documents submitted by the Contractor in respect of Interim Payment Certificate, 80 % of the admissible gross value of Interim Payment Certificate on provisional basis within 7 days after Engineer receives the statement and supporting documents and after taking into account all recoveries including retention amount on 100 % of the value of Interim Payment Certificate. All the statutory deductions will be carried out on the amount payable to the Contractor. (ii) Balance 20% payment on any date between 7th day to 42nd day after the date of receipt of the statement and after taking into account of balance adjustment, statutory deductions & recoveries, if any. In case it is discovered that the Contractor has billed excess amount than that admissible and amount released by the Engineer in 7 days in b(i) was more than 100% of the admissible amount, the Employer shall charge and recover interest on the amount in excess of 80 % due net payment from the next payment to the Contractor at the interest rate mentioned in Sub-Clause 14.2 (a) of these Particular Conditions for the number of days the excess amount was with the Contractor reckoned from the date of its actual payment till the adjustment / recovery of the same. In case of such events becoming repetitive, the Engineer shall withdraw such a facility of provisional payment specified under b(i) above and the Contractor shall have no claim whatsoever against the Employer. (iii) Provided always that payment against subsequent Interim Payment Certificate shall not be released until atleast one of the immediate preceding two Interim Payment Certificates has been fully paid under sub-clause 14.7 b (ii) above. In sub paragraph (c) of Sub –Clause 14.7: delete "56'' and substitute with "112". <u>Payment through Dedicated Joint Bank Account:</u> "Employer intends that funds released under the Contract as advance or against work done is utilized for the works under the Contract itself and Contractor & their sub-contractors/sub- vendors are not able to divert project funds to their other business /purposes. The Contractor shall provide a detailed month-wise cash flow estimate at

	the beginning of each financial year duly revised at quarterly interval, if required, so by the Engineer. The submission to and consent by the Engineer of such programmes or the provision of such general descriptions or cash flow estimates shall not relieve the Contractor of any of his duties or responsibilities under the Contract. All payments to be made by the Employer to the Contractor shall be released only through designated dedicated Joint Bank Account. The designated dedicated Joint Bank Account shall be opened by the Contractor in joint name of Contractor and the Employer with an "A" class Bank in Nepal after Notification of Award. Details of the Joint Bank Account shall be submitted by the Contractor with the Employer before submitting request for payment under the Contractor including mobilization advance. The designated Joint Bank Account shall be jointly operated by Contractor and Employer. For this purpose, appropriate authorization for the operation of Bank account will be done by Employer and Contractor. Dedicated Joint Bank Account Mechanism shall also apply to the sub-contractors/sub-vendors for works or any part thereof having substantial value of works say 10% of the Accepted Contract Amount. During the currency of the Contract, Contractor or sub-contractors or sub-vendors or all of them may become subject to any scheme of Corporate Debt Restructuring or any other scheme of debt restructuring (DR Scheme). Since the Dedicated Joint Bank Account involves an independent tripartite agreement between the Employer and the Contractor/Sub Contractor/Sub Vendors the Dedicated Joint Bank Account Agreement shall have an overriding effect over the terms & conditions of the DR Scheme, if any. The Dedicated Joint Bank Account Account/Agreement shall not be affected by the terms and conditions of the DR Scheme and the Contractor or its sub-Contractor /Sub vendors shall be required to disclose this condition to the DR Authorities while submitting the case under DR.

14.8 Delayed Payment	The clause is replaced with the following: Omissions on the part of the Engineer to pay the amount due upon measurement or otherwise shall neither vitiate nor make the Contract void. Further, no claim for interest or damages will be entertained or payable by the Employer upon i) any Bank Guarantee or ii) payments in arrears or iii) any balance which may become due on final settlement / re-conciliation of the account or iv) withheld by the Employer owing to any dispute or difference between the Parties. Save as above, if the Contractor does not receive undisputed payment in accordance with Sub-clause 14.7 b (i) & (ii) [Payment], the Contractor shall be entitled to receive simple interest as financing charges on the amount unpaid during the period of delay. This period shall be deemed to commence on the date for payment specified in Sub-Clause 14.7 [Payment], irrespective (in the case of its sub-paragraph (b)) of the date on which any Interim Payment Certificate is issued. These financing charges shall be calculated at the rate stated in Appendix to Tender. The Contractor shall be entitled to this payment without formal notice or certification and without prejudice to any other right or remedy. Further no interest will be paid on disputed claim / amount.
14.9 Payment of Retention Money	At the beginning of Sub-Clause 14.9, insert: The Contractor may substitute the Retention Money with a bank guarantee in the form, and from a source, acceptable to the Employer valid till the end of Defects Notification Period. The bank guarantee for the amounts expressed in Nepalese Rupees shall be issued by any Class-A bank in Nepal. The Bank Guarantees in currencies other than NPR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal. Delete first and second paragraph of Sub-Clause 14.9 and substitute: Promptly after the latest Defect Notification Periods, the Retention Money shall be certified by the Engineer for payment to the Contractor (or return of the bank guarantee, which replaced the Retention Money). At the end of Sub-Clause 14.9, insert: In case the Contractor has substituted the retention money with a bank guarantee; the same shall be returned as per stipulation above.
14.10 Statement at Completion	Delete paragraph (c) of Sub-Clause14.10

14.15 **Currencies of Payment**	Delete Sub –Clause 14.15 and substitute with following: The Contract Price shall be paid in Nepalese Rupees (NPR) only. The following payments/deductions shall also be made in NPR only: (i) The payments and deductions under Sub-Clause 13.5 [Provisional Sums] and Sub-Clause 13.7 [Adjustments for Changes in Legislation] (ii) other payments and deductions under sub-paragraphs (a) to (d) of Sub-Clause 14.3 [Application for Interim Payment Certificates] (iii) payment of the damages specified in the Appendix to Tender (iv) other payments to the Employer by the Contractor shall be made in the currency in which the sum was expended by the Employer, or in such currency as may be agreed by both Parties.
15 Termination by Employer	
15.2 **Termination by Employer**	At the end of sub-para (a) of Sub-Clause 15.2, add: or non insurance as per requirement of Clause 18 prolongs for a period of continuous two months, In Sub-Clause 15.2 "14 days" in 2nd para be replaced by "42 days", In Sub-Clause 15.2, add subparagraph (g) after subparagraph (f) as below: (g) if in the judgment of the Employer, the Contractor has engaged in fraudulent or corrupt or collusive or coercive practices, in competing for or in executing the Contract.
15.4 **Payment after Termination**	At the end of Sub-Clause 15.4 add: If the total amount due to the Employer exceeds payment due to the Contractor, the difference shall be a debt payable to the Employer.
16 Suspension and Termination by Contractor	
16.1 **Contractor's Entitlement to Suspend Work**	In Sub-Clause 16.1: "21 days" appearing in 1st paragraph of Sub-Clause 16.1 be replaced by "56 days" Para (b) of sub-clause 16.1 is deleted and substituted by the following: "(b) payment of any such Cost, which shall be included in the Contract Price. "
16.2 **Termination by Contractor**	Delete subparagraph (d) of Sub-Clause 16.2. "14 days" time period in penultimate paragraph be replaced by "42 days".

16.4 Payment on Termination	Delete paragraph (c) of sub-clause 16.4.
17 Risk And Responsibility	
17.1 Indemnities	In the 1st para of sub-clause 17.1 add the following text after the words *"The Contractor*": "including permitted assignee".
17.2 Contractor's Care of the Works	At the end of Sub-Clause 17.2 add: Upon request of the Contractor, the Engineer may allow an interest bearing advance for redoing cost in respective IPC (in proportion of NPR and foreign currency to the cost of redoing/ repair of damaged work) against submission of Bank guarantee (in proportion of the currencies in which advance/payment is being released) amounting to 110% of the advance/payment to be released to the Contractor. The rate of interest shall be the rate as stated in the Appendix to Tender against sub-clause 14.2, prevailing on the date of release of the advance. Interest shall be recovered on monthly rest basis from monthly IPC. If due to any reason the interest could not be recovered from the respective IPC it would be added to the principal for calculation of the interest for subsequent months. On settlement of the insurance claim the Contractor shall deposit the complete amount settled by the insurance company and balance, if any, shall be recovered by the Engineer in mutually agreed installments so that the whole of the amount is recovered before certification of the 90% of Accepted Contract Amount.
17.3 Employer's Risks	In sub-paragraph(b) of the Sub-Clause 17.3 delete word "terrorism" In sub-paragraph (c) of the Sub-Clause 17.3 delete word "riot"
17.6 Limitation of Liability	In Sub-Clause 17.6, retain only first paragraph. Contents after first paragraph are deleted.
18 Insurance	
18.1 General Requirement of Insurance	In the 3rd para from the end of sub-clause 18.1 add the following text after the words *"---accordingly*": "or the amount may be recovered from any money due to the insuring party. The amount so paid by the other party shall be considered as debt at interest as applicable under clause 14.2 prevailing on the date of release of payment". At the end of Sub-Clause 18.1, add the following: The insurance under this Contract shall be effected with either of

	following insurers: "Government / Public Sector insurance companies of Nepalese or Indian origin."
18.2 **Insurance for Works and Contractor's Equipment**	Delete first sentence of Sub-Clause 18.2 and substitute: The insuring Party shall insure the Works, Plants, Materials and Contractor's Documents for not less than 125% of Accepted Contract Amount in the joint name with Employer as principal insured. The policies are to be reviewed periodically to maintain them at not less than full replacement cost. In addition to above, policy(ies) shall cover cost of demolition, removal of debris, professional fees, escalation. Insurance policy shall have an express provision to the effect that the insurer shall necessarily obtain prior 'no objection' certificate from the Engineer before payment of insurance claim under the insurance policy. Delete sub-para (c), (d) and (e) of Sub-Clause 18.2 and substitute: (c) shall cover all loss and damage from any cause except sub para (a) to (g) listed in Sub-Clause 17.3 [Employer's Risks] (d) shall also cover loss or Damage to a part of the Works which is attributable to the use or occupation by the Employer of another part of the Works and loss or Damage from the risks listed in Sub-paragraph (c), (g) and (h) of Sub-Clause 17.3 [Employer's Risks], with deductibles per occurrence of not more than the amount stated in the Appendix to Tender (if an amount is not so stated, this Sub-paragraph (d)shall not apply), and (e) The excess amount deducted from the settled claim amount shall be borne by the Contractor and the Employer in proportion to the amount of the share of risk relating to respective parties in settled claim. Delete last paragraph of Sub-Clause 18.2. At the end of Sub-Clause 18.2, add: If the Contractor receives instructions from the Employer to insure against any risk listed in sub para (a) to (g) listed in Sub-Clause 17.3 [Employer's Risks], such insurance if available shall be affected, at the cost of the Employer, with an Insurance Company acceptable to the Employer and shall be in the joint names of the Contractor and the Employer.
19 Force Majeure	
19.4 **Consequences of Force Majeure**	Delete sub-para (b) of Sub-Clause 19.4, and Substitute: (b) not withstanding provisions elsewhere provided in the Contract for cost compensation resulting from extension of Time for Completion, if the event or circumstance is of the kind

	described in sub-paragraph (i) to (iv) of Sub-Clause 19.1[Definition of Force Majeure] and, in the case of sub-paragraphs (ii) to (iv) occurs in the Country, payment of 50% of such Cost.
20 Claims, Disputes and Arbitration	
20.1 Contractor's Claims	**Sub-Clause-20.1 'Contractor's Claim' – from para 5 to para 7 i.e. "Within 42 days after the Contractor……..as he has been able to substantiate" is modified and replaced as under:** Within 42 days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim or within such other period as may be proposed by the Contractor and approved by the Engineer, the Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time. If the event or circumstance giving rise to the claim has a continuing effect: a) this fully detailed claim shall be considered as interim, b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed and such further particulars as the Engineer may reasonably require; and c) the Contractor shall send a final claim within 28 days after the end of the effects resulting from the event or circumstance or within such other period as may be proposed by the Contractor and approved by the Engineer. Within 90 days after receiving all particulars supporting claim or within such other period as may be proposed by the Engineer and approved by the Contractor, the Engineer shall respond with approval or with disapproval and detailed comments. Each Payment Certificate shall include such amounts for any claim as have been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim under the Contract, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate. Further, the resources (Equipment/Manpower) shown in the Data Sheet are solely the Contractor's estimate and the Contractor has committed to deploy the resources indicated to complete the Works within the Time for Completion. No claims will be entertained on the grounds that there has been less progress than anticipated using these resources. The causes or hindrances would have to be established by the Contractor independently. By making these Data Sheets as part of the Contract does not absolve the Contractor from the

	responsibility of deploying additional resources to complete the Works within Time for Completion. No payments would be made towards the expenses incurred on deploying the additional resources as such unless expressly agreed by the Employer in writing. No interest shall be paid by the Employer on the disputed/ claimed amount for the period upto determination and notification of the same to the Contractor by the Engineer/announcement of the reasoned award by the IE/CCIE.
20.2 Appointment of the Independent Engineer	The sub-heading 'Appointment of the Dispute Adjudication Board' under Sub-Clause 20.2 is replaced with '**Appointment of the Independent Engineer**' and the text in the sub-clause stands deleted and substituted with the following: Disagreement shall be adjudicated by an Independent Engineer (IE) in accordance with Sub-Clause 20.4 [Obtaining Independent Engineer's Decision]. The Parties i.e. Employer & Contractor shall jointly select one Member out of three members proposed by the contractor from the panel of domain specific Experts being maintained by Ministry of Power (MoP), Government of India to act as Independent Engineer for the Contract. The appointment shall be made within 28 days of signing of Contract Agreement and shall be valid upto Time for Completion specified under Sub-Clause 1.1.3.3 [Time for Completion]. It shall be ensured that there is no conflict of interest and IE has not been engaged for providing any other services to any of the Parties in the last three years. The term of appointment of IE can be further renewed on a year-on-year basis as may be mutually agreed between the Employer and the Contractor subject to the consent of IE and final approval by the MoP. The agreement between the Parties and the IE shall incorporate by reference the General Conditions of Independent Engineer Agreement contained in the Appendix to these Conditions, with such amendments as are agreed between them. The terms of the remuneration of IE, shall be as specified in the General Conditions of Independent Engineer Agreement. The cost and expenses of IE shall be equally shared by both Parties. In the event of non-performance of obligations/services by the IEs at any time during the duration of its contract, the Employer and the Contractor, on mutually agreed basis, shall have the right and discretion to terminate IEs contract by giving a termination notice of thirty (30) days to IE. The appointment of the IE can only be terminated by mutual agreement of both Parties, but not by the Employer or the Contractor acting alone. In case the expert is dropped by the Ministry from its panel, a new expert would be selected by the Parties for performing the duties of IE. The replacement shall be appointed in the same manner as the

	replaced person was required to have been nominated, as described in this Sub-Clause.
20.3 Failure to Agree Independent Engineer	The sub-heading 'Failure to Agree Dispute Adjudication Board' under Sub-Clause 20.3 is replaced with '**Failure to Agree Independent Engineer**' and the text in the sub-clause stands deleted and substituted with the following: If any of the following conditions apply, namely: (a) the Parties fail to agree upon the appointment of the Independent Engineer by the date stated in the first paragraph of Sub-Clause 20.2, or (b) the Parties fail to agree upon the appointment of a replacement person within 42 days after the date on which the IE declines to or is unable to act as a result of death, disability, resignation or termination of appointment, removal from MoP's panel etc., then the IE shall be appointed by draw of lots among the experts named in the panel of MoP. This appointment shall be final and conclusive.
20.4 Obtaining Independent Engineer's Decision	The sub-heading 'Obtaining Dispute Adjudication Board's Decision' under Sub-Clause 20.4 is replaced with '**Obtaining Independent Engineer's Decision**' and the text in the sub-clause stands deleted and substituted with the following: If a disagreement (of any kind whatsoever) arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works, including any disagreement as to any certificate, determination, instruction, opinion or valuation of the Employer, then either Party may refer the disagreement in writing to the IE for its decision, with a copy to the other Party. Such reference shall state that it is given under this Sub-Clause and shall be in the Standard Format for Disagreement filing attached as Form-B. Necessary documentary evidences shall be submitted with the reference. The reference will not be admissible without initial documentary evidence. IE shall act as per the Standard Operating Procedure (SOP) attached as Form-A. IE will examine the issue(s) referred by the Parties by conducting inspections involving field measurements as may be required to further investigate and to also conduct hearing/mediation with both the parties. Based on the preliminary hearing of the Parties, IE shall prescribe resolution timeline depending upon the number and nature of disagreements subject to a maximum duration of thirty (30) days or within extended timeline under extraordinary circumstances and for reasons to be recorded in writing. Both Parties shall promptly make available to the IE all information, access to the Site, and appropriate facilities, as the IE may require for the

	purposes of making a decision on such dispute. Necessary information sought by IE during the course of investigation shall be provided in a time bound manner by both the Parties and non-compliance of the same shall lead to imposition of penalties by the IE. The IE shall be deemed to be not acting as arbitrator. The IE's decision shall be reasoned and shall state that it is given under this Sub-Clause. However, if the Parties have not paid in full the invoices submitted by IE pursuant to Clause 6 of the Appendix, the IE shall not be obliged to give its decision until such invoices have been paid in full. The decision shall be binding on both Parties, who shall promptly give effect to it unless and until it shall be revised in an amicable settlement or an arbitral award as described below. Unless the Contract has already been abandoned, repudiated or terminated, the Contractor shall continue to proceed with the Works in accordance with the Contract. If either Party is dissatisfied with the IE's decision, then either Party may, within 28 days after receiving the decision, give notice to the other Party of its dissatisfaction. If the IE fails to give its decision within the period of 30 days (or extended timeline) after receiving such reference, then either Party may, within 28 days after this period has expired, give notice to the other Party of its dissatisfaction. In either event, this notice of dissatisfaction shall state that it is given under this Sub-Clause, and shall set out the matter in dispute and the reason(s) for dissatisfaction. Except as stated in Sub-Clause 20.7 [Failure to Comply with Independent Engineer's Decision] and Sub-Clause 20.8 [Expiry of Independent Engineer's Appointment], neither Party shall be entitled to commence arbitration of a dispute unless a notice of dissatisfaction has been given in accordance with this Sub-Clause. If the IE has given its decision as to a matter in disagreement to both Parties, and no notice of dissatisfaction has been given by either Party within 28 days after it received the IE's decision, then the decision shall become final and binding upon both Parties.
20.6 Arbitration	Sub- Clause 20.6 stands deleted and substituted with the following: "Conciliation Committee of Independent Experts (CCIE) for Contractual Disputes in Projects implemented by CPSUs/Statutory Bodies under administrative control of Ministry of Power will address the disputes in terms of MOP's F.No. 11/22/2021-Th.II dated 29.12.2021(Annexure-VIII)
20.7 Failure to Comply with Independent Engineer's Decision	The sub-heading 'Failure to Comply with Dispute Adjudication Board's Decision' under Sub-Clause 20.7 is replaced with '**Failure to Comply with Independent Engineer's Decision**' and the text in the sub-clause stands deleted and substituted with the following: In the event that: (a) neither Party has given notice of dissatisfaction within the period

	stated in Sub-Clause 20.4 [Obtaining Independent Engineer's Decision], (b) the IE's related decision (if any) has become final and binding, and (c) a Party fails to comply with this decision, then the other Party may, without prejudice to any other rights it may have, refer the failure itself to arbitration under Sub-Clause 20.6 [Arbitration]. Sub-Clause 20.4 [Obtaining Independent Engineer's Decision] and Sub-Clause 20.5 [Amicable Settlement] shall not apply to this reference.
20.8 Expiry of Independent Engineer's Appointment	The sub-heading 'Expiry of Dispute Adjudication Board's Appointment' under Sub-Clause 20.8 is replaced with '**Expiry of Independent Engineer's Appointment**' and the text in the sub-clause stands deleted and substituted with the following: If a disagreement arises between the Parties in connection with, or arising out of, the Contract or the execution of the Works and there is no IE in place, by reason of the expiry of the IE's appointment: (a) Sub-Clause 20.4 [Obtaining Independent Engineer's Decision] and Sub-Clause 20.5 [Amicable Settlement] shall not apply, and (b) the dispute may be referred directly to arbitration under Sub-Clause 20.6 [Arbitration].
Appendix - General Conditions of Independent Engineer Agreement	The Appendix stands deleted and substituted with the following: 1 Definitions "Independent Engineer Agreement" is a tripartite agreement by and between: (a) the "Employer"; (b) the "Contractor"; and (c) the "Independent Engineer " The Employer and the Contractor have entered (or intend to enter) into a contract, which is called the "Contract" and is defined in the Independent Engineer Agreement, which incorporates this Appendix. In the Independent Engineer Agreement, words and expressions which are not otherwise defined shall have the meanings assigned to them in the Contract. 2 General Provisions The Independent Engineer Agreement shall take effect when the Employer, the Contractor and Independent Engineer have signed a dispute adjudication agreement. When the Independent Engineer Agreement has taken effect, the Employer and the Contractor shall each give notice to the Independent Engineer accordingly. If the Independent Engineer

	does not receive either notice within six months after entering into the Independent Engineer Agreement, it shall be void and ineffective. This employment of the Independent Engineer is a personal appointment. No assignment or subcontracting of the Independent Engineer Agreement is permitted without the prior written agreement of all the Parties to it. 3 Warranties The Independent Engineer warrants and agrees that he/she is and shall be impartial and independent of the Employer, the Contractor and the Employer's Representative. The Independent Engineer shall promptly disclose, to each of them, any fact or circumstance which might appear inconsistent with his/her warranty and agreement of impartiality and independence. 4 General Obligations of the Independent Engineer The Independent Engineer shall: (a) have no interest financial or otherwise in the Employer or the Contractor, nor any financial interest in the Contract except for payment under the Independent Engineer Agreement; (b) not previously have been employed as a consultant or otherwise by the Employer or the Contractor within last three years; (c) have disclosed in writing to the Employer and the Contractor, before entering into the Independent Engineer Agreement and to his/her best knowledge and recollection, any professional or personal relationships with any director, officer or employee of the Employer or the Contractor, and any previous involvement in the overall project of which the Contract forms part; (d) not, for the duration of the Independent Engineer Agreement, be employed as a consultant or otherwise by the Employer or the Contractor, except as may be agreed in writing by the Employer and the Contractor; (e) comply with the annexed procedural rules and with Sub-Clause 20.4 of the Conditions of Contract; (f) not give advice to the Employer, the Contractor, the Employer's Personnel or the Contractor's Personnel concerning the conduct of the Contract, other than in accordance with the annexed procedural rules; (g) not while an Independent Engineer enter into discussions or make any agreement with the Employer or the Contractor regarding employment by any of them, whether as a

	consultant or otherwise, after ceasing to act under the Independent Engineer Agreement; (h) ensure his/her availability for any site visit and hearings as are necessary; and (i) treat the details of the Contract and all the IE's activities and hearings as private and confidential, and not publish or disclose them without the prior written consent of the Employer and the Contractor. 5 General Obligations of the Employer and the Contractor The Employer, the Contractor, the Employer's Personnel and the Contractor's Personnel shall not request advice from or consultation with the Independent Engineer regarding the Contract, otherwise than in the normal course of the IE's activities under the Contract and the Independent Engineer Agreement, and except to the extent that prior agreement is given by the Employer and the Contractor. The Employer and the Contractor shall be responsible for compliance with this provision, by the Employer's Personnel and the Contractor's Personnel respectively. The Employer and the Contractor undertake to each other and to the Independent Engineer shall not, except as otherwise agreed in writing by the Employer and the Contractor: (a) be appointed as an arbitrator in any arbitration under the Contract; (b) be called as a witness to give evidence concerning any dispute before arbitrator(s) appointed for any arbitration under the Contract; or (c) be liable for any claims for anything done or omitted in the discharge or purported discharge of the Independent Engineer 's functions, unless the act or omission is shown to have been in bad faith. The Employer and the Contractor hereby jointly and severally indemnify and hold the Independent Engineer harmless against and from claims from which he/she is relieved from liability under the preceding paragraph. 6 Payment The Independent Engineer shall be paid as follows: (a) Retainership Fee : A retainer fee of Rs.100,000 per Month fixed for FY 2021-22 for 'Independent Engineer' which shall be considered as payment in full for : i. being available on a notice of 2 weeks for' all site visits and hearings;

	ii. becoming and remaining conversant with all the project developments and maintaining relevant files; and iii. compensating all office and overhead expenses including secretarial services, photocopying and office supplies incurred in connection with his duties. The retainer fee of Independent Engineer, shall be increased annually by 10%. Further, an Expert, shall not be in the retainership of more than two contracts concurrently with the same Employer. In case of two contracts, IE shall draw retainership fee limited to one contract only i.e. Rs.100,000 (referred to for FY 21-22). The duration of retainership shall be for such duration as may be mutually decided by the Employer and Contractor but shall not in any case extend beyond 3 months after the completion of works as per the Contract. The retainership fee shall be shared by the Employer and the Contractor equally but shall initially be paid to the IE by the Employer. (b) Site Visit Fee : A daily visiting fee of Rs 20,000/- (fixed for FY 21-22) to either project site or project office, anywhere in India, limited to a maximum of 10 days in a month for Expert, shall be paid for hearing, preparing reports etc. The daily fee shall be shared by the Employer and the Contractor equally but shall initially be paid to the IE by the Employer. The daily visiting fee of Expert, as mentioned above, shall be increased on yearly basis @10%. (c) Reimbursement of travel, boarding/lodging expenses incurred by 'Independent Engineer': The travel, boarding/lodging expenses of the 'Independent Engineer, as per entitlement of Executive Director of Employer, would be paid initially by the Contractor. If any expert of 'Independent Engineer' does not receive payment of the amount due within 30 days after submitting claim, the expert shall be free to suspend his/her services without notice until the payment is received. (d) Meeting Expenses: All the payments for holding the meeting would be initially paid by the Contractor and shall be shared equally by the Employer and Contractor. (e) Sharing of Expenses on Independent Engineer : All the payments for holding the meeting, site visits, reimbursement of travel, boarding/lodging expenses and monthly compensation of 'Independent Engineer' shall be shared equally by both the parties i.e. Employer and Contractor. 7 Default of the Independent Engineer

	If the IE fails to comply with any obligation under Clause 4, he/she shall not be entitled to any fees or expenses hereunder and shall, without prejudice to their other rights, reimburse each of the Employer and the Contractor for any fees and expenses received by the IE, for proceedings or decisions (if any) of the IE which are rendered void or ineffective. 8 Dispute Any dispute or claim arising out of or in connection with this Agreement, or the breach, termination or invalidity thereof, shall be finally settled under the Rules of Arbitration of the Arbitration Institute referred in Sub-Clause 20.6 [Arbitration] by one arbitrator appointed in accordance with these Rules.
Annex - Procedural Rules	The Annex stands deleted and substituted with the following: 1 The Employer and the Contractor shall furnish to the IE one copy of all documents which the IE may request, including Contract documents, progress reports, variation instructions, certificates and other documents pertinent to the matter in disagreement. All communications between the IE and the Employer or the Contractor shall be copied to the other Party. 2 The IE shall proceed in accordance with Sub-Clause 20.4 and these Rules. Subject to the time allowed to give notice of a decision and other relevant factors, the IE shall: (a) act fairly and impartially as between the Employer and the Contractor, giving each of them a reasonable opportunity of putting his case and responding to the other's case, and (b) adopt procedures suitable to the disagreement, avoiding unnecessary delay or expense. 3 The IE may conduct a hearing on the disagreement, in which event it will decide on the date and place for the hearing and may request that written documentation and arguments from the Employer and the Contractor be presented to it prior to or at the hearing. 4 Except as otherwise agreed in writing by the Employer and the Contractor, the IE shall have power to adopt an inquisitorial procedure, to refuse admission to hearings or audience at hearings to any persons other than representatives of the Employer and the Contractor, and to proceed in the absence of any party who the IE is satisfied received notice of the hearing; but shall have discretion to decide whether and to what extent this power may be exercised. 5 The Employer and the Contractor empower the IE, among other things, to: (a) establish the procedure to be applied in deciding a disagreement,

	(b) decide upon the IE's own jurisdiction, and as to the scope of any disagreement referred to it, (c) conduct any hearing as it thinks fit, not being bound by any rules or procedures other than those contained in the Contract and these Rules, (d) take the initiative in ascertaining the facts and matters required for a decision, (e) make use of its own specialist knowledge, if any, (f) decide upon the payment of financing charges in accordance with the Contract, (g) decide upon any provisional relief such as interim or conservatory measures, and (h) open up, review and revise any certificate, decision, determination, instruction, opinion or valuation of the Employer, relevant to the disagreement. 6 The IE shall not express any opinions during any hearing concerning the merits of any arguments advanced by the Parties. Thereafter, the IE shall make and give its decision in accordance with Sub-Clause 20.4, or as otherwise agreed by the Employer and the Contractor in writing.

Form-A

(Refer sub-clause 20.4 of PCC)

Standard Operating Procedure (SOP) for Independent Engineer

S. No.	Key Tasks	Stakeholder involvement	Activity description	Proposed Timeline
1	Reference of Disagreement	– Contractor – Employer	Case Filing — A Disagreement begins when claimant party submits a demand for intervention by IE in the prescribed format along with documentary evidence. Demand without initial documentary evidence will not be admissible for IE intervention.	Day 0
2	Preliminary Hearing & Scheduling	– Independent Engineer – Contractor – Employer	Preliminary hearing and scheduling process- IE to organize a preliminary hearing with the parties and prescribe suitable timeline for resolution or settlement.	Day 1 to Day 6
3	Finalisation of Issues	– Independent Engineer	Finalisation of Issues — After due examination and diligence to finalise the issues requiring resolution.	Day 3 to 9
4	Hearing/ Mediation	– Independent Engineer – Contractor – Employer	Hearing / Mediation—The parties and IE meet in person to conduct the Hearings.	Day 4 to 12
5	Inspection	– Independent Engineer	Inspection- IE conducts the inspections involving field measurements, if any, to further investigate evidence conferred to the IE by both parties during the hearing.	Day 5 to 17
6	Post Inspection Briefs	– Independent Engineer – Contractor – Employer	Post-Inspection Briefs - After the inspection takes place; both the parties may come up with additional testimony, as permitted by the IE.	Day 10 to 30
7	Closure	– Independent Engineer	Closure - IE closes the report on the case and issues a decision, along with any claim settlement, if applicable.	Day 10 to 30

Form-B

Standard Format for Disagreement Filing

1. Name of Party	2. Disagreement Reporting Date	3 Has the documentary Evidence been Submitted
4 Contract Reference number	5. Party Representative Name Reporting Disagreement	❑ Yes ❑ No ❑ Not Applicable
	Name: Contact Details:	
6. Name of Independent Engineer IE	7. IE Contact details	8. Disagreement Reference Number (to be allocated by IE)
9. Supplementary Note Recording the Disagreement		
[Text] Documentary Evidences to be Annexed		
10. Critical Engineering Expertise Relevant to Investigate the Disagreement (Check All Required)		
❑ Engineering Design ❑ Geology ❑ Civil works ❑ Hydro Mechanical ❑ Electro Mechanical ❑Electrical Switchgear ❑ Quality Assurance & Inspection		

11. Record Notes of Preliminary hearing Organized by IE with the parties
[Text] Documentary Evidences by Parties along with MoM to be Annexed
12. Brief Narration on discovery process - after Preliminary hearing & listing of next step to examine the issues and procedural difficulties relating to the case
[Text] Documentary Evidences to be Annexed
13. Record notes of Hearing/Mediation between the parties and IE
[Text] Documentary Evidences with Video Records to be Annexed
14. Inspection Records with Field Measurements Conducted by IE
[Text] Documentary Evidences to be Annexed
15. Record notes of Inspection Briefs by IE along with additional testimony by the Parties if any
[Text] Documentary Evidences & inspection Reports to be Annexed
16. Closure Report by IE with Decision & Claim settlement if applicable
[Text] Documentary Evidences to be Annexed
Final Acceptance by All the Parties

APPENDIX TO TENDER

[Note: with the exception of the items for which the Employer's requirements have been inserted, the following information must be completed before the Tender is submitted]

Item	Sub-clause	Data
Employer's name and address	1.1.2.2 & 1.3	SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC), Satluj Bhawan, Arun Sadan, Tumlingtar, Nepal
Contractor's name and address	1.1.2.3 & 1.3	----------
Engineer's name and address	1.1.2.4 &1.3	To be nominated by the Employer
Time for Completion of the Works	1.1.3.3	9 months reckoned from date of Letter of Acceptance
Defects Notification Period	1.1.3.7	365 days
Electronic transmission system	1.3	e-mail
Governing Law	1.4	Laws of Govt. of Nepal, t**he courts in Nepal shall have exclusive jurisdiction.**
Ruling language	1.4	English
Language for communications	1.4	English
Time for access to the site	2.1	The access to Site(s) shall be granted within 15 days from the date of issuance of LOA.
% above which Engineer shall obtain specific approval of Employer	3.1	As per internal delegation of power of level of Engineer
Idle Time Cost Claim	3.5	Refer Annexure-I
Amount of Performance Security…..	4.2	3% of the Accepted Contract Amount, in the currencies and proportions in which the Contract Price is payable.
Amount of Performance Security for Sub Contractor's Performance…..	4.2	3% of the value of sub contracted works, in the currencies and proportions in which the Contract Price is payable.
Delay Damages for the Works as a whole	8.7	0.05% of the Accepted Contract Amount per day of delay in completion of Works as a whole.
Maximum amount of Delay Damages on account of work as a whole	8.7	10% of the Accepted Contract Amount.
Adjustments for changes in Cost	13.8	Biratnagar/Itahari

- Place of nearest fuel Depot		
Interest rate (on advance)	14.2 & 14.5	For NPR & Foreign Currency (INR); 10.40 % based on SBI India, MCLR published on 15.01.2023 which includes 200 points on MCLR and as further amended by SBI time to time
Percentage of Retention Money	14.3	5 %
Plant and Materials intended for the Works	14.5(c)(i)	Cement, Steel, Diesel, Explosives,
Delayed Payments, Interest rate for delayed payments	14.8	8 % per annum
Insuring party	18.1, 18.2, 18.3	Insuring party is the "Contractor".
Maximum amount of deductibles for insurance of the Employer's risks as well as other risks	18.2(d)	5% of each loss subject to a minimum of NPR 5.0 Million.
Minimum amount of third party insurance	18.3	NPR 100 million on reinstatement basis
The institution name shall be	20.6	CCIE-MOP, GOI in terms of MOP's F.No. 11/22/2021-Th.II dated 29.12.2021

Annexure-I

(Refer Sub-clause 3.5, Appendix to Tender)

Procedure for determination of Cost related to extension of Time for Completion:

The valuation of idling time cost claims of the Contractor's shall cover compensation for idling time related cost as given below:

(a) Cost of owned/leased/hired Equipment

Cost of owned Equipment will comprise of the following elements:

i. Depreciation Cost

Annual Depreciation = 0.9 × Book Value/Life in years.
(Based on life in years)

Depreciation cost = {(Idle period in days/365) × 0.50 × Annual Depreciation}.

However, if the equipment has completed its scheduled life in years, in that case the depreciation shall be considered as zero.

ii. Interest on capital Investment: (Rate of Interest # /100) × Average Annual Cost

The average annual cost is determined as follows:

Average Annual Cost = Book value of Equipment × (n+1)/2n

Where:

- "n" refer for number in years of life of equipment.
- Book value = purchase price plus freight, insurance, all taxes and duties, port clearance charges, erection and commissioning charges and other incidental charges.

the interest rate shall be the rate of interest applicable for Construction Equipment advance in the Contract.

iii. Insurance Charges

Insurance charges in respect of insurance policy applicable and availed for the Equipment shall be considered as per actuals.

(b) Cost of Labour

The labour directly engaged for the works at Site by the Contractor or through Subcontractor, as verified by the Engineer, will be reimbursed for idle period in case Contractor produces proof that idle labour has been paid wages during the period of idling.

Cost of equipment related labour, as verified by Engineer, will be worked out as per CWC norms limited to actual whichever is lower.

The above cost will be considered for payment based on the supporting details such as attendance sheet, receipt of deposit of provident fund duly certified by the Contractor.

In addition to actual cost of labour, indirect charges shall be considered. The indirect charges (other than salary) shall be 50% for skilled and unskilled labour. Indirect charges shall be applicable on the basic wages. Basic wages means component of wages on which statutory deductions like Employee Provident Fund is deposited to the statutory authority.

(c) Cost of Site staff

The Cost of site executives/supervisory staff shall be considered for payment as per actual. The site staff implies all the staff posted at the site excluding staff posted at the Head office. Cost of site staff shall be supported by relevant documents. The cost shall be considered for payment based on the supporting details in form of pay ledger, bank details, detailed pay slips, proof of Income tax deduction at source issued by the Contractor as well as Subcontractor's and receipt of deposit of Provident Fund duly certified by the Contractor. In this head, staff physically deployed at site shall only be considered.

(d) Interest on Mobilization Advance

The Contractor shall give amount of expenditure along with their period duly certified by their statutory auditors towards the utilization of the mobilization advance for the Works. On the basis of the certification made by the Statutory Auditor an average investment for the period may be considered and the amount of interest on mobilization advance worked out accordingly. Further, for the purpose of calculation of interest on mobilization advance, interest rate as mentioned in the relevant Contract shall be considered. The cost of construction equipment purchased by the Contractor out of the mobilization advance on which interest on capital investment is already considered at Sl.No. a (ii) above shall be excluded for the purpose of working out interest on Mobilization advance.

However, where the events giving rise to admissible cost claim to the Contractor do not disrupt whole of the Works but only particular component/structure of the Project, then the admissible interest on mobilization advance payable to the Contractor shall be worked out on prorata basis.

(e) Overheads

Overhead costs include but not limited to Office and share of head office expenses, Legal charges, general establishment, watch and ward, local conveyance, travelling expenses, social welfare, salaries of managerial and clerical staff etc. and publicity etc.

$$\text{Overhead Charges} = \frac{(3\%) \text{ of Accepted Contract Amount} \times \text{authorized Time Extension entitling cost claim}}{\text{Contractual Construction Period}}$$

The lump-sum component of overhead as (3%) shall cover all other charges not included expressly in any of the items of claim at Sl. (a) to (e) as above.

(f) Bank Guarantees and Insurance charges

These charges are to be considered towards cost compensation for the idle period based upon documentary evidence of payment of premium amount by the Contractor towards Performance Bank Guarantee, Retention Money Bank Guarantee and Contractor's All Risk (CAR) Insurance Policy.

(g) The taxes applicable on cost claims

The applicable taxes on the above elements of cost claim shall be reimbursed to the Contractor as per actuals based on the documentary evidence.

Annexure-II

DELETED

Annexure-III
(Refer clause 13.8)

Calculation of weightages for Price Adjustment Formula:

(All values in %)

Components	Fixed	Steel	Labour (Skilled)	Labour (Un-Skilled)	Oxygen	Electrodes	Cement	POL	Other Materials	Machinery Charges
	F	s	l	u	b	e	c	d	m	P
Category-I	15	59	6	8	1	2	-	2	4	3
Category-II	15	60	7	8	-	-	-	4	4	2
Category-III	15	-	4	7	-	-	53	2	15	4
Category-IV	15	-	12	9	-	-	-	21	22	21
Category-V	15	-	15	17	-	-	-	14	21	18

1. LETTER OF TENDER

{Refer ITB Clause-13.1, 14 & 21.2 (a)}

Name of Contract.....

To : (Name and Address of Employer)

Sir,

1.0 Having examined the Bid Documents, including Addenda Nos. *(Insert Numbers)*, the receipt of which is hereby acknowledged, we the undersigned, offer to construct and install such Works and remedy the defects therein in conformity with the Conditions of Contract, Specifications, Drawings, Bill of Quantities, Appendix to Bid and addenda (if any) for the sum of :

.....***(Prices to be left blank in Envelope-I*** (Insert amounts in words)
.....(.....)
(Amount in Figures)
as specified in the Appendix to Bid or such other sums as may be determined in accordance with the terms and conditions of the Contract.

2.0 **Attachments to the Letter of Tender:**

In line with the requirement of the Bid Documents we enclose herewith the following Attachments to the Letter of Tender:

(a) **Attachment1:** Bid Security in the form of Bank Guarantee/FDR/DD (in original) No.---------- dated---------- issued by ---------- [Name and address of the Bank] for a sum of ..... *(Name of currency and amounts in words & figures)* valid upto and including [date 90 days after the period of bid validity].

(b) **Attachment 2:** A power of attorney complying with the requirement of ITB Clause No. 5.1(a) indicating that the person(s) signing the bid have the authority to sign the bid and thus that the bid is binding upon us during the full period of its validity in accordance with the ITB Clause 17.

(c) **Attachment 3:** The documentary evidence establishing in accordance with ITB Clause 3 that we are eligible to bid and in terms of ITB Clause 5.1(e) are qualified to perform the contract if our bid is accepted. The qualification details have been furnished as per your format enclosed with the Bid Documents.

(d) **Attachment 4:** The details of local representation as per your format enclosed in the Bid Documents.

(e) **Attachment 5**: Bidders Appreciation of the project.

It should include a report on the site inspection, awareness and understanding of all the principal, technical and logistic problems related to transportation and erection of the construction equipment, materials, availability of land, infrastructure, local taxes & laws and construction of works. (ITB clause no. 8).

(f) **Attachment 6:** Bids with subcontractor:

Bids submitted by a bidder with subcontractor shall comply with the following requirements:

(i) Undertakings by the Bidder and his subcontractor that the Bidder /subcontractors shall be responsible for execution of that item of work for which they claim to have specific construction experience.

(ii) A Joint Deed of Undertaking by the Bidder and his subcontractor.

(g) **Attachment 7**: Bids by Merged/Acquired/subsidiary company:

Bids submitted by a subsidiary company shall comply with the following requirements:

(i) Undertaking by the Parent/holding Company evincing full technical and financial support to the subsidiary and commitment by the parent/holding company to take up the work itself in case of non-performance of the subsidiary company and to provide additional performance guarantee and also to enter into separate agreement with the Employer to that effect.

(h) **Attachment-8**: Undertaking regarding blacklisting.

Undertaking regarding blacklisting in accordance with Sub-Clause-3.2 of ITB.

(i) **Attachment-9:** Joint Venture/Consortium Agreement (attested by Notary Public) and signed between Lead Partner and the other Partner of JV/C as per Sub-Clause-13.2(i) of ITB.

#.....

 # (Any other Attachment, if required, shall be added here)

3.0 **Bill of Quantities:**

3.1 In line with the requirements of the Bid Documents, we enclose herewith the Bill of Quantities, duly filled-in as per your proforma.

@.....**(Prices to be left blank in Envelope-I submission)** .....

@ Any other Schedule if required, shall be added here.

3.2 We are aware that the Bill of Quantities do not generally give a full description of the work to be performed under each item and we shall be deemed to have read the Technical Specifications and other Bid Documents and Drawings to ascertain the full scope of work included in each item while filling-in rates and prices. We agree that entered rates and prices shall be deemed to include for the full scope as aforesaid, including applicable taxes, duties, cess & levies etc and overhead and profit.

3.3 We declare that as specified in General Condition of Contract (Clause13.7 & 13.8) and Particular Condition of Contract (Sub Clause 13.7 & 13.8), the rates of Bill of Quantities shall be subject to adjustment. Our prices are inclusive of all the applicable taxes, duties, levies, cess, royalties and octroi for the performance of the Contract.

4.0 We confirm that we shall get registered with the concerned VAT/Taxation Authorities, in Nepal where the project is located. We also confirm that we shall produce the Permanent Account Number issued by Nepalese Income Tax Authorities to the Engineer within 28 days from the date of issue of the Letter of Acceptance.

4.1 We confirm that no VAT/Entry tax/levies in any form shall be payable by you for the bought out items which are dispatched directly by us/our assignee to the project Site.

5.0 We undertake, if our bid is accepted, to commence the work immediately upon your Letter of Acceptance to us, and to achieve Completion of Works within the time stated in the Bid Documents.

6.0 If our bid is accepted, we undertake to provide a Performance Security in the form and amounts, and within the time specified in the Bid Documents.

7.0 We agree to abide by this bid for a period of 180 days from the date fixed for submission of bids as stipulated in the Bid Documents, and it shall remain binding upon us and may be accepted by you at any time before the expiration of that period.

8.0 Commissions or gratuities, if any, paid or to be paid by us to agents relating to this Bid, and to contract execution if we are awarded the contract, are listed below:

Name and address of agent	Amount and Currency*	Purpose of Commission or gratuity
….....	.....	.....

(if none, state “none”)”. ****(Prices to be left blank in Envelope-I)***

9.0 Until a formal Contract is prepared and executed between us, this bid, together with your written acceptance thereof in the form of your Letter of Acceptance shall constitute a binding contract between us.

10.0 We understand that you are not bound to accept the lowest or any bid you may receive. We acknowledge the right of the Employer to reject our Bid without assigning any reason or otherwise and hereby waive our right to challenge the same on any account whatsoever.

11.0 All information provided in my/our Bid and attachments thereof is true and correct and all documents copies of which are attached with our Bid as attachments are true copies of their respective originals.

12.0 I/ We hereby certify that I/we */ any of the Joint Venture/Consortium Members (the "JV Members")* have not been banned /de-listed/black listed/debarred from business by Government of Nepal or any of its Government Department during last 03 (three) years on grounds of corrupt/fraudulent practices and/or due to non-performance and/or by Ministry of Power, Government of India/SJVN/SAPDC on any grounds.

13.0 I/We hereby declare that only the persons or firms interested in this proposal as principals are named in our Bid and that no other person or firm or company other than those mentioned in our Bid has any interest in this bid submission or in the Contract to be entered into and in good faith, without collusion or fraud, if our Bid is accepted as evidenced by issue of Letter of Acceptance to us.

14.0 We understand that you may annul the bidding process and reject all bids or accept or reject any of the bids at any time and that you are neither bound to accept any bid that you may receive nor to invite the Bidders to bid for Works, without incurring any liability to all or any of the Bidders.

15.0 We declare that we/any Member of our Joint Venture/Consortium are/is not a Member of any other Joint Venture/Consortium submitting a Bid for the Works pursuant to the Bid Document.

16.0 We have studied all the Bid Documents carefully and also surveyed the Works Site and understood all local and site conditions affecting the execution of the Works. We understand that except to the extent as expressly set forth in the Contract, we shall have no claim, right or title arising out of any documents or information provided to us by the Employer or in respect of any matter arising out of or concerning or relating to the bidding process including the award of Works to the selected bidder.

17.0 We acknowledge and confirm that upon issue of Letter of Acceptance to us consequent to acceptance of our Bid, a binding contract for execution of the Works shall come into existence on the terms set forth in our Bid together with your Letter of Acceptance. We undertake to commence the work upon issue of your said Letter of Acceptance, and to achieve Completion within the time stipulated in the Bid Documents.

18.0 We agree and understand that the Bid is subject to the provisions of the Bid Documents. In no case, we shall have any claim or right of whatsoever nature if the Works is not awarded to us or our Bid is not opened.

19.0 We, hereby, declare that only the persons or firms interested in this proposal as principals are named here and that no other persons or firms other than those mentioned herein have any interest in this proposal or in the Contract to be entered into, if the award is made on us, that this proposal is made without any connection with any other person, firm or party likewise submitting a proposal is in all respects for and in good faith, without corrupt/fraudulent/collusive/coercive practice .

Dated this.....day of.....20--

Thanking you, we remain,

Yours faithfully,

(Signature)
(Printed Name)
(Designation)
(Common Seal)

Date :
Place :

Business Address:
Country of Incorporation:
(State or Province to be indicated)

Name & Address of the Principal Officer:

ATTACHMENT - 1
{Refer ITB Clause-18}

(To be stamped in accordance with Stamp Act
if any, of the Country of the Issuing Bank)

Bid Security Form

Bank Guarantee

Date:_____

(Name of Contract)

To: (Name and address of Employer)

WHEREAS (name of Bidder) (hereinafter called "the Bidder") has submitted its Bid dated (date of bid) for the performance of the above-named Contract (hereinafter called "the Bid")

KNOW ALL PERSONS by these present that WE (name of Bank) of (address of bank) (hereinafter called "the Bank"), are bound unto (name of Employer) (hereinafter called "the Employer") for the sum of: (amount), for which payment well and truly to be made to the said Employer, the Bank binds itself, its successors and assigns by these presents.

THE CONDITIONS of this obligation are as follows:

1. If the Bidder withdraws its Bid during the period of bid validity, or adopts corrupt or collusive or coercive or fraudulent practices.

2. If the Bidder, having been notified of the acceptance of its Bid by the Employer during the period of bid validity.

a) fails or refuses to sign the Contract Agreement when required, or

b) fails or refuses to submit the performance security in accordance with the Bid Documents.
.

We undertake to pay to the Employer up to the above amount upon receipt of its first written demand, without the Employer having to substantiate its demand, provided

that in its demand the Employer will mention that the amount claimed by it is due, owing to the occurrence of one or both of the two above-named conditions, and specifying the occurred condition or conditions.

(**)

This guarantee will remain in force up to and including (date 90 days after the period of bid validity), and any demand in respect thereof must reach the Bank not later than the above date.

For and on behalf of the Bank

_____

in the capacity of

_____

Common Seal of the Bank

Note: 1. (**) Employer may also present any of his demands at the counters of the .....*(Name and address of the branch of the Bank in Nepal)*.....for further relay to us.
(To be inserted in case of a foreign currency bank guarantee issued by an overseas bank outside Nepal)

INSTRUCTIONS FOR EXECUTION OF BANK GUARANTEE FOR BID SECURITY

1. For the purpose of Stamp Duty on the Bank Guarantee, the law prevalent in the country of execution of Bank Guarantee shall prevail.

2. The executing officers of the Bank Guarantee for Earnest Money/Bid Security shall clearly indicate in (block letters) his name, designation, Power of Attorney No. / Signing Power No. as well as telephone/ fax numbers with full correspondence address of the issuing Guarantee etc.

3. Each page of the Bank guarantee for Earnest Money Deposit shall be duly signed/initialed by the executing officers and the last page shall be signed in full, indicating the particulars as aforesaid (sub-para 2) under the seal of the Bank.

4. Bank Guarantee in NPR should be executed on letter head of the "A" class commercial Bank. The issuing Bank shall be requested independently for verification/confirmation of the Bank Guarantee issued, non confirmation of which may lead to rejection of 'Bid Security. *The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal.*
5. Bank Guarantee for Bid security in original shall be submitted alongwith the Bid.

*ATTACHMENT-2 (i)
{Refer ITB Sub- Clause-5.1 a)}

POWER OF ATTORNEY

(on letter head of the firm)

KNOW ALL MEN BY THESE PRESENTS THAT WE M/S ……., A COMPANY ORGANISED AND EXISTING UNDER THE LAWS OF (NAME OF COUNTRY ……..……) AND HAVING ITS REGISTERED/PRINCIPAL OFFICE /PLACE OF BUSINESS AT……..……..……REPRESENTED BY (NAME OF PERSONS) (THE "EXECUTANT") DO HEREBY NOMINATE, CONSTITUTE, AUTHORIZE AND APPOINT MR. [……*Name of Attorney*……] , SON OF [……..…], RESIDENT OF [……] AND PRESENTLY EMPLOYED WITH], A COMPANY/ CORPORATION ORGANISED AND EXISTING UNDER THE LAWS OF ……. (NAME OF THE COUNTRY) AND HAVING ITS REGISTERED OFFICE/PRINCIPAL PLACE OF BUSINESS AT ……..……. AS OUR TRUE AND LAWFUL ATTORNEY (THE "ATTORNEY") TO DO IN OUR NAME AND ON OUR BEHALF ALL OR ANY OF THE FOLLOWING ACTS, DEEDS AND THINGS IN CONNECTION WITH OR IN RESPECT OF OR RELATING TO THE NOTICE INVITING TENDER NO. …… DATED ……. (THE "NIT") ISSUED BY SJVN ARUN-3 POWER DEVELOPMENT COMPANY (P) Ltd. (SAPDC), A COMPANY ORGANISED AND EXISTING UNDER THE LAWS OF NEPAL AND HAVING ITS REGISTERED OFFICE/PRINCILPAL PLACE OF BUSINESS (AT ……(THE "EMPLOYER") FOR THE EXECUTION, CONSTRUCTION AND DEVELOPMENT OF THE WORKS DESCRIBED IN THE NOTICE INVITING TENDER (NIT) (THE "WORKS") THAT IS TO SAY:

1. TO PREPARE, OFFER, SIGN, SUBMIT AND DELIVER TO THE EMPLOYER THE EXECUTANT'S BID FOR THE WORKS PURSUANT TO THE NIT (THE "BID") INCLUDING TO MAKE, SIGN(JV/Consortium Agreement), SUBMIT, DELIVER, EXECUTE, AND ACCEPT ALL DOCUMENTS, INCLUDING JOINT VENTURE/CONSORTIUM AGREEMENT, INFORMATION, APPLICATIONS AND OTHER WRITINGS NECESSARY FOR OR INCIDENTAL TO THE SIGNING, SUBMISSION AND DELIVERY OF THE BID TO THE EMPLOYER;

2. TO NEGOTIATE, ENTER INTO, SIGN AND EXECUTE, ACCEPT AND DELIVER ALL CONTRACTS UNDERTAKINGS, ACCEPTANCES AND OTHER WRITINGS CONSEQUENT UPON ACCEPTANCE OF THE EXECUTANT'S BID;

3. PARTICIPATE IN BIDDERS' AND OTHER CONFERENCES AND PROVIDE ALL INFORMATION REQUIRED BY THE EMPLOYER AND

TO FURNISH/SEEK CLARIFICATIONS ARISING OUT OF OR RELATING TO THE NIT AND, UPON AWARD OF THE CONTRACT CONSEQUENT TO THE ACCEPTANCE OF THE EXECUTANT'S BID BY THE EMPLOYER;

4. TO REPRESENT AND ACT ON BEHALF OF THE EXECUTANT IN RESPECT OF ALL MATTERS BEFORE THE EMPLOYER RELATING TO THE EXECUTANT TO BID AND UPON THE ACCEPTANCE OF THE EXECUTANT'S BID BY THE EMPLOYER INCLUDING THE RESULTANT CONTRAT ON SUCH THE ACCEPTANCE OF THE EXECUTANT'S BID (THE "CONTRACT") IN RESPECT OF ALL MATTERS RELATING TO OR ARISING OUT OF OR CONCERNING THE CONTRACT AND TO GENERALLY DEAL WITH THE EMPLOYER ON BEHALF OF THE EXECUTANT IN ALL MATTERS ARISING OUT OF OR IN CONNECTION WITH OR RELATING TO OR ARISING OUT OF THE EXECUTANT'S BID. THE NIT AND THE CONTRACT IN THE EVENT OF ACCEPTANCE OF THE EXECUTANT'S BID BY THE EMPLOYER;

5. AND GENERALLY TO DO ANY AND ALL OTHER AND FURTHER ACTS, DEEDS AND THINGS WHICH ARE NECESSARY FOR OR INCIDENTAL TO OR DEEMED APPROPRIATE FOR MORE EFFECTUAL EXERCISE OF THE POWERS HEREBY CONFERRED.

AND We, the Executant above named do hereby agree and undertake to ratify and confirm and do hereby ratify and confirm all acts, deeds and things lawfully done or caused to be done by our said Attorney pursuant to and in exercise of the powers hereby conferred and all acts, deeds and things done or caused to be done by our said Attorney pursuant hereto shall always be deemed to be the acts, deeds and things done by the Company itself.

IN WITNESS WHEREOF, THIS POWER OF ATTORNEY ON THIS [……] DAY OF [……..], [20…..]……. ……. has been executed under the common seal of the Company, at ----------(name of place).

For [Name of the Executant]

By ……

(Name of Officer)

Title

WITNESSES

1.

2.

[Notarized]

Notes:

- The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.
- The Bidder should submit for verification the extract of the charter documents and documents such as a resolution of its Board of Director/ power of attorney in favour of the person executing this Power of Attorney for delegation of power hereunder on behalf of the Bidder.
- Power of Attorneys executed by foreign Bidders shall be duly stamped in accordance with applicable law in Nepal.

* Strike out the form, if not applicable for the bidder.

***ATTACHMENT-2 (ii)**

POWER OF ATTORNEY OF LEAD MEMBER OF THE CONSORTIUM/JOINT VENTURE

Whereas the [Name and Address of the Employer] (the "Employer") has by its Notice Inviting Tender (NIT) No. …… dated …….. (the "NIT") invited to bids for construction of the works described therein (the "Works"); and

Whereas, _....., ... and ……..(collectively the "Joint Venture" or "Consortium") being Members of the Joint Venture with …… as its leader (the "Lead Member") are interested in bidding for the Works in accordance with the terms and conditions of the "Bid Documents", and

Whereas it is necessary for the Members of the Joint Venture to vest the Lead Member with all necessary power and authority to do for and on behalf of the Joint Venture, all acts, deeds and things as may be necessary in connection with the Joint Venture's bid for the Works and its execution.

NOW THEREFORE KNOW ALL MEN BY THESE PRESENTS WE

(i) [……..], a company organized and existing under the laws of […….] and having its registered office at [……..] represented by (name of Person) and

(ii) ……., a company organized and existing under the laws of […….] and having its registered office at [……..] represented by (name of Person) (Collectively the "JV Members") do hereby irrevocably designate, constitute, nominate, appoint and authorize the Lead Member …….., a company organized and existing under the laws of ……. and having its Registered Office at …….. as the Leader of the Joint Venture and our duly constituted true and lawful Attorney (hereinafter called the 'Attorney') to do for and in respect of or relating to proposed Bid of the Joint Venture for the Works in response to the NIT dated ---- (the "JV Bid") and in the event of acceptance of JV Bid in our name and on our behalf all or any of the following acts, deeds and things that is to say:

1. To represent the Joint Venture and each of the JV Members in all dealings with the Employer in relation to the JV Bid and upon acceptance of the JV Bid and consequent award of the contract to the Joint Venture (the "Contract") with respect to all matter arising out of or relating or incidental to the Contract;

2. To prepare, sign, submit and deliver to the EMPLOYER the JV Bid for the works pursuant to the above NIT including to sign, submit and deliver, execute, accept and deliver all documents, information, applications and other

writings necessary for or incidental to the signing, submission and delivery of the Bid.

3. To negotiate, enter into, sign and execute, accept and deliver the Contract and all other undertakings, acceptances and writings consequent upon acceptance of the JV Bid by the Employer;

4. Participate in Bidders and other conferences and provide all information required by the EMPLOYER and to furnish/seek clarifications arising out of or relating to the Bid Document and the JV Bid and the Contract in the event of acceptance of the JV Bid by the EMPLOYER;

5. To represent and act on behalf of the Joint Venture and the JV Members in respect of all matters before the EMPLOYER relating to the Joint Venture, the JV Bid and, upon the acceptance of the JV Bid by the EMPLOYER including the resultant Contract on such the acceptance of the JV Bid, in respect of all matters relating to or arising out of or concerning the Contract and to generally deal with the EMPLOYER on behalf of the Joint Venture and the JV Members in all matters arising out of or in connection with or relating to or arising out of the Bid Document, the JV Bid and the Contract in the event of acceptance of the JV Bid by the EMPLOYER;

6. To sub-delegate all or any of the powers hereby conferred to such person or persons including any employees of the Attorney and/or of all or any of the JV Members as the Attorney may in its sole discretion deem appropriate;

7. And generally to do any and all other and further acts, deeds and things which are necessary for or incidental to or deemed appropriate for more effectual exercise of the powers hereby conferred.

AND nothing contained herein shall derogate from the Attorney's responsibility as leader of the Joint Venture to ensure performance of the Contract including performance of their respective portion of the Contract by the JV Members. Provided however all the JV Members shall be jointly and severally liable for performance of the Contract and failure of one or more of the JV Members to perform their respective portions of the Contract shall be deemed to be a default by all the JV Members.

AND we the above named JV Members do hereby declare that this power of Attorney shall remain valid, binding and irrevocable till the earlier of the completion of the Defect Notification Period in terms of the Contract(s) if the JV Bid is accepted by the Employer, or the award of the Works under the NIT dated ----- to any other bidder.

AND we the above named JV Members do hereby agree and undertake to ratify and confirm and do hereby ratify and confirm all acts, deeds and things lawfully done or caused to be done by our said Attorney pursuant to and in exercise of the powers hereby conferred and all acts, deeds and things done or caused to be done by our said Attorney in exercise of the power hereby conferred shall always be deemed to be the acts, deeds and things done by the Joint Venture Company.

In witness whereof we the JV Members above named have executed this Power of Attorney on this ……. day of ……. under their respective common seal(s), at ---------- (name of place).

COMMON SEAL

(1) For [……]
By _____

[(Signature of authorized representative)]
Name: ……
Designation: Director.

The common Seal of [……] has been affixed, pursuant to the resolution passed by its Board of Directors at their meeting held on […….], in the presence of Mr. [……..], Director who has affixed his signatures hereinabove in confirmation thereof.

(2) For [----------]
By _____

(Signature of authorized representative)
Name: ……
Designation: Director.

The common Seal of [……] has been affixed, pursuant to the resolution passed by its Board of Directors at their meeting held on […….], in the presence of Mr. [……..], Director who has affixed his signatures hereinabove in confirmation thereof.

Note:

- The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executants and when it is so required, the same should be under common seal affixed in accordance with the required procedure, and

- Shall be signed by the authorized representatives of each Member of the Joint Venture / Consortium.

- Copy of charter documents and documents such as resolution/other Authorization in favour of executants of Power of Attorney is attached hereto for verification.

- Power of Attorneys executed by foreign Bidders shall be duly stamped in accordance with applicable law in Nepal.

* Strike out the form, if not applicable for the bidder.

ATTACHMENT - 3

Form of Declaration

(Refer ITB Sub-clause 5.1.e)

A DECLARATION IN RESPECT OF THE SUBMITTED BID DOCUMENTS/ PROPOSALS

Subject: In respect of Domestic Competitive Bidding for Execution of **Package - _____of _____ Hydroelectric Project.** It is declared without any reservation whatsoever that:

1) The submitted Techno-Commercial/Price Bid proposals are without any deviations and are strictly in conformity with the documents issued by the Employer.

2) In case any deviations are noticed which might have crept inadvertently, that such deviations without reservation of any kind are automatically deemed to have been withdrawn by us.

3) We are familiar with all the requirements of the Contract and has not been influenced by any statement or promise of any person of the Employer.

4) We are experienced and competent Bidder to perform the Contract to the satisfaction of Employer and are familiar with all general and special laws, acts, ordinances, rules and regulations of the Municipalities, District, State and Central Government of Nepal that may affect the work, its performance or personnels employed therein.

5) We hereby authorize the Employer to seek reference from our bankers for its financial position and undertake to abide by all labour welfare legislations.

6) The above statement submitted by us is true and correct to our best knowledge.

(To be Jointly Signed by all the authorized representatives of each of the Members of the Joint Venture or Consortium) .....

.....

.....

.....

N.B: WITHOUT THIS CERTIFICATE BID IS LIABLE TO BE REJECTED.

ATTACHMENT – 4
{Refer ITB Clause-13.3(d)}

(Name of the Project)
(Details in respect of Local Agent)

(Bidder's Name & Address) :

To:.....
(Name of the Employer)

Dear Sir,

We furnish below the following information in respect of our local agent:

(i) Name and address of the local agent

.....

.....

.....

.....

(ii) Services to be rendered by the local agent

.....

.....

.....

.....

.....

Date : ..... (Signature).....

Place : ..... (Printed Name).....

(Designation).....

(Common Seal).....

ATTACHMENT – 5
{Refer ITB Clause-8.0}

Bidder's Appreciation of the Project

It should include a report on the site inspection, awareness and understanding of all the principal, technical and logistic problems related to transportation and installation/handling of the construction equipment/ materials, availability of land, infrastructure, local taxes & laws and construction of works (ITB clause no. 8).

***ATTACHMENT- 6 (i)**

UNDERTAKING FROM SUBCONTRACTOR

{Refer ITB Clause-5.3(i)}

No: …… Date: **……...**

To,
.....,
.....
.....

Dear Sirs,
We, M/s…….. having registered office at ……do hereby undertake that in case work ……..(Name of work) is awarded to M/s …….. (Name of the Bidder), we shall execute the work of "_____" (the components of the work for which the Bidder has proposed to associate the subcontractor), as subcontractor to M/s…… (Name of the Bidder) and we shall be responsible for successful completion of the job covered under our scope for which we shall submit a joint Deed of Undertaking as per approved format of Employer included in the Bid Document and also agree to provide an additional Performance Bank Guarantee of 3% (three percent) of value of sub-let portion of works in addition to normal Performance Bank Guarantee, as per the format included in the Bid Document.

We do hereby also confirm that we are not participating either as a sole Bidder or as a partner of a Joint Venture/consortium Bidder against the above Notice Inviting Tender.

Yours faithfully,

For & on behalf of M/s. ……..
(Name & Address of the Subcontractor)

(Office Seal)

Station:
Date:

Note: ***i)*** *This letter of Authorization should be on the letterhead of the subcontractor and should be signed by a person competent and having the Power of attorney to bind the subcontractor. Power of Attorney in favour of this person to do so may be enclosed with this Letter of Undertaking.*

ii) In case a bidder/JV has been qualified for any of the work on the credential of a proposed subcontractor of the bidder/JV partner, he shall be required to submit a joint deed of undertaking (as per agreed format) from the proposed subcontractor and contractor for joint and several responsibility of execution of Work sub-contracted to the subcontractor.

* Strike out the form, if not applicable by the bidder.

***ATTACHMENT- 6 (ii)**

PROFORMA OF JOINT DEED OF UNDERTAKING BY THE SUBCONTRACTOR AND THE BIDDER/CONTRACTOR

{Refer ITB Clause-5.3(ii)}

THIS DEED OF UNDERTAKING executed this ……. day of……. Two Thousand and …… by M/s. …….., a Company incorporated under the laws of …… and having its Registered Office at …….. (hereinafter called the "Subcontractor" which expression shall include its successors, executors and permitted assigns), and M/s……., a Company incorporated under the laws of ……. having its Registered Office at ……. (hereinafter called the "Bidder" which expression shall include its successors, executors and permitted/ assigns) in favour of SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC), Tumlingtar, Nepal (hereinafter called the "Employer" which expression shall include its successors, executors and permitted assigns)

WHEREAS the "Employer" invited Bids vide its Invitation No. …….. for Construction of **_____, .** AND
WHEREAS ITB Clause No. 5.3(iii) of, Vol.–0 forming part of the Bid Documents inter-alia stipulates that a in order to ensure serious participation of the Subcontractor(s) for work proposed to be executed by the Subcontractor(s), a Joint Deed of Undertaking shall be required to be submitted by the Contractor and Subcontractor(s)
AND WHEREAS the Bidder has submitted its Bid to the Employer vide Reference No. ……..…..……. dated ……. based on the association of the Subcontractor.

NOW THEREFORE THIS UNDERTAKING WITNESSETH as under:

1.0 In consideration of the award of Contract by the Employer to the Bidder (hereinafter referred to as the "Contractor") we, the Subcontractor and the Bidder/Contractor do hereby declare that we shall be jointly and severally bound to the SAPDC Pvt. Ltd. for the successful performance of the * (*proposed sub-let works*) in accordance with the Contract.

2.0 Without in any way affecting the generality and total responsibility in terms of this Deed of Undertaking, the Subcontractor in particular hereby agrees to deploy and depute its technical personnel, equipment, manpower and/or other resources on continual basis throughout the construction period of the proposed sub-let works until its completion to discharge the obligations of the Contractor under the Contract.

3.0 This Deed of Undertaking shall be construed and interpreted in accordance with the laws of Nepal and the Courts in …… shall have exclusive jurisdiction in all matters arising under the Undertaking.

4.0 Apart from the Contractor's Performance Guarantee, the Subcontractor shall furnish as security, a Contract Performance Guarantee from its Bank in favour of the Employer in a form acceptable to the Employer. The value of such guarantee shall be

equivalent to 5% (five percent) of value of the proposed sub-let works as identified in the Contract awarded by the Employer to the Bidder/Contractor and it shall be an additional guarantee for faithful performance/compliance of this Deed of Undertaking in terms of the Contract. The guarantee shall be unconditional, irrevocable and valid till the completion of the part of the Works executed by the Subcontractor. The Bank Guarantee amount shall be payable to the Employer on demand without any reservation or demur.

5.0 We, the Subcontractor and the Bidder/Contractor agree that this Undertaking shall be irrevocable and shall form an integral part of the Contract and further agree that this Undertaking shall continue to be enforceable till it is discharged by the Employer. It shall become operative from the Commencement Date of the Contract.

IN WITNESS WHEREOF, the Subcontractor and the Bidder/Contractor have through their Authorised Representatives executed these presents and affixed Common seals of their respective Companies, on the day, month and year first above mentioned, at ----------(name of place).

WITNESS	For Subcontractor
1. ……..….	Signature of Authorized
(Signature)	(Representative)
(Name in Block Letter)	Name …….....…….
(Office Address)	Common Seal of Company
	……...……
	For Bidder/Contractor
2. ……...….	Signature of Authorized
(Signature)	(Representative)
(Name in Block Letter)	Name....…….
(Office Address)	Common Seal of Company
	…….....

This Joint Undertaking is to be given if the Contractor qualifies on the strength of Subcontractor.

(To be Notarized by Notary Public)

***ATTACHMENT 7(i)**

UNDERTAKING BY THE PARENT/HOLDING COMPANY

{Refer ITB Clause-5.4 (i)}

(On letter head of Parent/Holding Company)

No: …… Date:……..

To,

(Name and Address of Employer)

Sub: Invitation for Bidding for Package _____- of _____ **HE Project, _____.**

Dear Sirs,

We, M/s …….. (Name of the Parent/Holding Company) having registered office at ……(Address of the Parent/Holding Company)……do hereby undertake that in case work of Construction of Package - _____, _____ H.E. Project is awarded to M/s …… (Name of the Bidder), who is participating in your subject Tender as a Sole Bidder/constituent of JV/Consortium partner, which is our subsidiary company, we on our strength/strength of -----(name of group company(ies)) under our control shall provide the full support for technical and financial requirements for the work "----------" (the scope of work of subsidiary company) and we shall be responsible for successful completion of the job covered under the scope of M/s ……. .(Name of Subsidiary company).

In case the Bidder, M/s …….(Name of Subsidiary company) gets qualified/techno-commercially responsive and awarded the work, We do hereby undertake;

(i) to enter into a separate agreement with the Employer as per the Employer's approved format included in the Bid documents.

(ii) to furnish an additional performance Bank guarantee of value equivalent to five (5%) percent of the Contract Price/five (5%) percent of the portion of work (where the Subsidiary Company is a Joint Venture Partner/Consortium Bidder) as the case may be, if the subsidiary Company is qualified on the strength of Parent Company or group company(ies) under the control of Parent/Holding Company.

We do hereby also confirm that we are not participating either as a sole Bidder or as a subcontractor against the above Invitation.

Yours faithfully,

For & on behalf of M/s. ……..

(Name & Address of the Parent/holding Company)

(Office Seal)

Station:
Date:

Note: **This letter of authorization should be on the letterhead of the Parent/Holding Company and should be signed by a person competent and having the Power of attorney to bind the Parent/Holding Company. Power of Attorney in favour of this person to do so be enclosed with this Letter of Undertaking.**

* : undertaking to be given by the parent/holding company if Subsidiary company was prequalified on the strength of parent/holding company.

*ATTACHMENT-7 (ii)
PARENT/HOLDING COMPANY AGREEMENT

{Refer ITB Clause-5.4 (ii)}

(For sole Bidder)

THIS AGREEMENT IS MADE on this the…… day of …… between the ……, a company incorporated under the laws of Nepal and having its Registered and Corporate Office at …….(hereinafter referred to as the 'Employer' which expression shall unless repugnant to the subject or context or meaning thereof include its successors, administrators, executors and assigns) of the one part; and …….(name of Parent/holding Company) a company organized and existing under the laws of…… and having its Principal Office at ……. (Hereinafter referred to as the "Parent/holding Company" which expression shall unless repugnant to the subject or context or meaning thereof include its successors, administrators, executors and assigns) of the other part;

WHEREAS on the Parent/holding Company's commitment to provide full support for technical and financial requirements and be responsible and liable for successful completion of the works being awarded to M/s…….. (name of Subsidiary Company) and further agreeing to enter into a separate agreement with the Employer besides furnishing an additional Performance Bank Guarantee of value equivalent to 3% of the Contract Price, the Employer has entered into a Contract with M/s …….. …….(hereinafter referred to as the "Bidder" which expression shall unless repugnant to the subject or context or meaning thereof include its successors, administrators, executors and permitted assigns) for the execution of Package - _____, _____ H.E. Project**.** (hereinafter referred to as the "Contract").

And whereas, in consideration of the aforesaid commitment, the Parent/holding Company hereby enters into this agreement with the Employer for providing full support for technical and financial requirements to the Bidder and be responsible and liable for successful performance and completion of the works described in the said Contract on the following terms and conditions:

NOW THEREFORE THE PARTIES HERETO HEREBY AGREE AND THIS AGREEMENT WITNESSETH AS FOLLOWS:

1. In this Agreement except where the context otherwise requires, the following expressions shall have the meaning hereinafter respectively assigned to them:

2. "Contract" shall mean the Contract dated …… entered into between the Employer and the Bidder for the execution of the Work described therein for Package - _____, _____ H.E. Project

3.(a) The Parent/holding Company hereby agrees to the Employer to ensure due and faithful performance of the obligations and liabilities by the Bidder under the Contract and remain responsible to irrevocably and unconditionally provide full technical and financial support to the Bidder for completion of the works covered under the Contract. The provisions of Contract shall mutatis-mutandis apply to the Parent/holding Company.

3. (b) In the event of breach and/ or failure on the part of the Bidder to perform or fulfill any of its obligations and liabilities under the Contract, the Employer may at its discretion call upon the Parent/holding Company and the Parent/holding Company shall be obliged to execute and perform or cause to be executed and performed and to satisfy the obligations and liabilities of the Bidder under the Contract in accordance with the terms and conditions thereof without prejudice to any other right or remedy, besides encashing the Bank guarantee(s).

3(c) The Parent/holding Company shall indemnify and keep indemnified and harmless the Employer at all times against any loss, damage, cost charge and expense whatsoever that may be suffered or incurred by or caused to the Employer on account of such breach.

3(d) It shall not be necessary for the Employer to proceed against the Bidder before proceeding against the Parent/holding Company and the Parent/holding Company shall be liable to fulfill its obligations and liabilities hereunder notwithstanding the Employer having undertaken any proceedings and/or obtaining any security from the Bidder for the performance of its obligations under the Contract. In order to give affect to this Agreement, the Employer may at its option be entitled to act as if the Parent/holding Company was the Bidder for successful completion of the works.

In the event, qualification of the Bidder/Subsidiary Company is considered on the credentials of another Subsidiary/Group Company under the same Apex 'Parent/holding Company' and due to any reason whatsoever, 'Parent/holding Company' or any other Group Company wants to divest its investment in the direct or indirect subsidiary (ies) as a result of which any of these companies may not remain subsidiary (ies) of the 'Parent/holding Company' then the 'Parent/holding Company' undertakes to ensure the performance of the works by arranging the required inputs in case of failure of Subsidiary Company.

3(e) However, where the Bidder disputes the occurrence of a breach under the Contract and if such dispute is referred to arbitration in terms of Conditions of the Contract, the Bidder is obliged to carry on the works under the Contract. In case, during the pendency of the dispute in arbitration, the Bidder does not carry on the work satisfactorily, the Employer by notice to the Parent/holding Company shall be entitled to invoke this Agreement, as if a breach had occurred for the purpose of Clause 3(b) hereinabove.

4. It is agreed that the obligations undertaken by the Parent/holding Company hereunder shall be performed by it notwithstanding any difference or dispute between the Employer and the Bidder pending before any court, tribunal, arbitration or any other authority or forum.

5. This Agreement shall come into force and effect upon the Commencement Date of the Contract/issuance of 'Letter of Acceptance' and shall remain in force and effective till the date of expiry of the DefectsNotification Period by the Employer pursuant to the Conditions for the Contract.

6. *"This Agreement is in addition to and without prejudice to the securities offered by and on behalf of Bidder to the Employer and all rights and remedies in respect thereof be reserved. This Agreement shall be a continuing guarantee and be in force notwithstanding discharge of Bidder by operation of any law or insolvency /bankruptcy /winding up/dissolution of the Bidder."*

7. The Employer shall have the full liberty from time to time to vary any of the terms and conditions of the Contract by mutual agreement between the Employer and the Bidder and to extend time for performance thereunder by the Bidder or any other party thereto in accordance with the terms of the Contract and / or to postpone for any time and from time to time any of the powers exercisable by the

   Employer against the Bidder and either to enforce or forebear from enforcing any of the terms and conditions of the Contract and/or the securities available to the Employer from the Bidder and the Parent/holding Company shall not be released from its obligations and liabilities under this Agreement in any manner whatsoever by any exercise by the Employer of the liberty and / or the rights with reference to the matters as aforesaid or by reason of time being given to the Bidder or any other act of forbearance, waiver or omission on the part of Employer or any indulgence by the Employer to the Bidder or of any other matter or thing whatsoever which under the law relating to sureties would but for this provision have the effect of releasing the Parent/holding Company from its obligations and liabilities hereunder.

8. Nothing contained in this Agreement shall be construed or interpreted in any way as modifying or amending or relieving in any manner whatsoever the Bidder from their obligations under the Contract.

9. This Agreement shall be interpreted and be governed under the Law of Nepal.

10. Any dispute or difference which may arise between the parties out of or in connection with this Agreement and which the Parties are unable to settle amicably shall be settled by reference to arbitration as per General/Particular Conditions of Contract. The venue of arbitration shall be ……and the arbitration shall be conducted in accordance with Nepal Arbitration Act – 2055 (1999). The courts of …….. shall have exclusive jurisdiction provided however that any award made in such arbitration shall be enforceable in any court of competent jurisdiction.

IN WITNESS WHEREOF THE PARTIES HERETO HAVE PUT THEIR HANDS HEREUNTO ON THE…… DAY ……. MONTH AND ……YEAR FIRST ABOVE WRITTEN AT _____.

For and on behalf of the Employer	For and on behalf of the Parent/holding Company
(through authorized representative)	(through duly authorized representative)
Witnesses:	Witnesses:

1. _____(Signatures) 1._____(Signatures)

(Name & Address) (Name & Address)

2. _____(Signatures) 2._____(Signatures)

(Name & Address) (Name & Address)

* Strike out the form, if not applicable by the bidder.

(Notarized by Notary Public)

***ATTACHMENT- 7 (iii)**

PARENT/HOLDING COMPANY AGREEMENT

{Refer ITB Clause-5.4 (iii)}

(For Joint Venture/Consortium)

THIS AGREEMENT IS MADE on this the…… day of …… between the ……a company incorporated under the laws of Nepal and having its Registered and Corporate office at …… (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the subject or context or meaning thereof include its successors, administrators, executors and assigns) of the one part; and …….(name of Parent/holding Company) a company organized and existing under the laws of…… and having its Principal Office at ……. (Hereinafter referred to as the "Parent/holding Company" of the Joint Venture Partner M/s ……which expression shall unless repugnant to the subject or context or meaning thereof include its respective successors, administrators, executors and assigns) of the other part;

WHEREAS on the Parent/holding Company's commitment to provide full support for technical and financial requirements and be responsible and liable for successful completion of the scope of works of M/s …….(name of Subsidiary Company) being awarded to Joint Venture of M/s…….. (name of Joint Venture) and further agreeing to enter into a separate agreement with the Employer besides furnishing an additional Performance Bank Guarantee of value equivalent to 3% of the Contract Price to the portion of work of M/s …… of Joint Venture, the Employer has entered into a Contract with the Joint Venture comprising M/s …… and M/s …….. …….(hereinafter referred to as the "Bidder" which expression shall unless repugnant to the subject or context or meaning thereof include their successors, administrators, executors and permitted assigns) for the execution of Package - _____, _____ H.E. Project**.** (hereinafter referred to as the "Contract").

And whereas, in consideration of the aforesaid commitment, the Parent/holding Company hereby enters into this agreement with the Employer for providing full support for technical and financial requirements to its Subsidiary M/s …… and be responsible and liable for successful performance and completion of the woks described in the said Contract on the following terms and conditions:

NOW THEREFORE THE PARTIES HERETO HEREBY AGREE AND THIS AGREEMENT WITNESSETH AS FOLLOWS:

1. In this Agreement except where the context otherwise requires, the following expressions shall have the meaning hereinafter respectively assigned to them:

2. "Contract" shall mean the Contract dated …… entered into between the Employer and the Bidder for the execution of the Work described therein for Package - _____, _____ H.E. Project**.**

3.(a) The Parent/holding Company hereby agrees to the Employer to ensure due and faithful performance of the obligations and liabilities by M/s ……

(name of Subsidiary Company) under the Contract and remain responsible to irrevocably and unconditionally provide full technical and financial support to M/s …… (name of Subsidiary Company) for completion of the works covered under the Contract. The provisions of Contract shall mutatis-mutandis apply to the Parent/holding Company.

3. (b) In the event of breach and/ or failure on the part of M/s …… (name of Subsidiary Company) to perform or fulfill any of its obligations and liabilities under the Contract, the Employer may at its discretion call upon the Parent/holding Company and the Parent/holding Company shall be obliged to execute and perform or cause to be executed and performed and to satisfy the obligations and liabilities of the Bidder under the Contract in accordance with the terms and conditions thereof without prejudice to any other right or remedy, besides enchasing the Bank guarantee(s).

3(c) The Parent/holding Company shall indemnify and keep indemnified and harmless the Employer at all times against any loss, damage, cost charge and expense whatsoever that may be suffered or incurred by or caused to the Employer on account of such breach.

3(d) It shall not be necessary for the Employer to proceed against the Bidder before proceeding against the Parent/holding Company and the Parent/holding Company shall be liable to fulfill its obligations and liabilities hereunder notwithstanding the Employer having undertaken any proceedings and/or obtaining any security from the Bidder for the performance of its obligations under the Contract. In order to give affect to this Agreement, the Employer may at its option be entitled to act as if the Parent/holding Company was the Bidder for successful completion of the works.

In the event, qualification of the Bidder/Subsidiary Company is considered on the credentials of another Subsidiary/Group Company under the same Apex 'Parent/holding Company' and due to any reason whatsoever, 'Parent/holding Company' or any other Group Company wants to divest its investment in the direct or indirect subsidiary (ies) as a result of which any of these companies may not remain subsidiary (ies) of the 'Parent/holding Company' then the 'Parent/holding Company' undertakes to ensure the performance of the works by arranging the required inputs in case of failure of Subsidiary Company.

3(e) However, where the Bidder disputes the occurrence of a breach under the Contract and if such dispute is referred to arbitration in terms of Conditions for the Contract, the Bidder is obliged to carry on the works under the Contract. In case, during the pendency of the dispute in arbitration, the Bidder does not carry on the work satisfactorily, the Employer by notice to the Parent/holding Company shall be entitled to invoke this Agreement, as if a breach had occurred for the purpose of Clause 3(b) hereinabove.

4. It is agreed that the obligations undertaken by the Parent/holding Company hereunder shall be performed by it notwithstanding any difference or dispute between the Employer and the Bidder pending before any court, tribunal, arbitration or any other authority or forum.

5. This Agreement shall come into force and effect upon the Commencement Date of the Contract/issuance of 'Letter of Acceptance' and shall remain in force and effective till the date of expiry of the Defects Notification Period by the Employer pursuant to the Conditions for the Contract.

6. This guarantee is in addition to and without prejudice to the securities offered by and on behalf of Bidder to the Employer and all rights and remedies in respect thereof be reserved. This guarantee shall be a continuing guarantee and be in force notwithstanding discharge of Bidder by operation of any law or insolvency /bankruptcy /winding up/dissolution of the Bidder.

7. The Employer shall have the full liberty from time to time to vary any of the terms and conditions of the Contract by mutual agreement between the Employer and the Bidder and to extend time for performance thereunder by the Bidder or any other party thereto in accordance with the terms of the Contract and / or to postpone for any time and from time to time any of the powers exercisable by the Employer against the Bidder and either to enforce or forebear from enforcing any of the terms and conditions of the Contract and/or the securities available to the Employer from the Bidder and the Parent/holding Company shall not be released from its obligations and liabilities under this Agreement in any manner whatsoever by any exercise by the Employer of the liberty and / or the rights with reference to the matters as aforesaid or by reason of time being given to the Bidder or any other act of forbearance, waiver or omission on the part of Employer or any indulgence by the Employer to the Bidder or of any other matter or thing whatsoever which under the law relating to sureties would but for this provision have the effect of releasing the Parent/holding Company from its obligations and liabilities hereunder.

8. Nothing contained in this Agreement shall be construed or interpreted in any way as modifying or amending or relieving in any manner whatsoever the Bidder from their obligations under the Contract.

9. This Agreement shall be interpreted and be governed under the Law of Nepal.

10. Any dispute or difference which may arise between the parties out of or in connection with this Agreement and which the Parties are unable to settle amicably shall be settled by reference to arbitration as per General/Particular Conditions of Contract. The arbitration shall be conducted in accordance with the Nepal Arbitration Act 2055 (1999) and rules of Arbitration Institute indicated in the contract. The courts of …… shall have exclusive jurisdiction provided however that any award made in such arbitration shall be enforceable in any court of competent jurisdiction.

IN WITNESS WHEREOF THE PARTIES HERETO HAVE PUT THEIR HANDS HEREUNTO ON THE…… DAY ……. MONTH AND ……YEAR FIRST ABOVE WRITTEN AT _____.

For and on behalf of the Employer	For and on behalf of the Parent/holding Company

(through authorized representative)	(through duly authorized representative)
Witnesses:	Witnesses:
1._____(Signatures)	1._____(Signatures)
(Name & Address)	(Name & Address)
2._____(Signatures)	2._____(Signatures)
(Name & Address)	(Name & Address)

* Strike out the form, if not applicable for the bidder

ATTACHMENT- 8

Integrity Pact alongwith Undertaking regarding Blacklisting

Between

SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC), a company incorporated under the Companies Act 2063 and having its registered office at Lokanthali, Kathmandu, Nepal, hereinafter referred to as "The Employer" which expression shall mean and include, unless the context otherwise requires, his successors in office and assigns of the **First Part.**

And

M/s……., a company/ firm/ individual (status of the company) constituted in accordance with the relevant law in the matter and having its registered office at …… represented by Sh. ……..Prop. hereinafter referred to as "The Bidder/Contractor" which expression shall mean and include, unless the context otherwise requires, his successors and permitted assigns of the **Second Part**.

WHEREAS the Employer proposes to procure under laid down organizational procedures, contract for "Civil works of Tail Race Pond, outfall of Arun-3 HEP and Intake Structure with Tunnel located in Sankhwasabha Distt. of Nepal" and the Bidder/contractor is willing to offer against TENDER NO/REF.: DCB-P&C-AHEP-C-7/2023-103 dated 17.02.2023.

NOW, THEREFORE,

To avoid all forms of corruption by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to:-

Enabling the Employer to obtain the desired said (work/ goods/ services) at a competitive price in conformity with the defined specifications by avoiding the high cost and the distortionary impact of corruption on public procurement, and

Enabling the Bidder(s)/Contractor(s) to abstain from bribing or indulging in any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and the Employer will commit to prevent corruption, in any form, by its officials by following transparent procedures.

1.0 Commitments of the Employer

1.1 The Employer undertakes that no official of the Employer, connected directly or indirectly with the contract, will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favour or any material or immaterial benefit or any other advantage from the Bidder/Contractor, either for themselves or for any person, organization or third party related to the contract in exchange for an advantage in the bidding process, bid evaluation, contracting or implementation process related to the contact.

1.2 The Employer will, during the pre-contract stage, treat all the Bidders/Contractors alike, and will provide to all the Bidders/Contractors the same information and will not provide any such information to any particular Bidder/Contractor which could afford an advantage to that particular Bidder/Contractor in comparison to other Bidders/Contractors.

1.3 All the officials of the Employer will report to the appropriate Authority any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach.

1.4 In case any such preceding misconduct on the part of such official(s) is reported by the Bidder to the Employer with full and verifiable facts and the same is prima facie found to be correct by the Employer, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings may be initiated by the Employer or Independent External Monitor and such a person shall be debarred from further dealings related to the contract process. In such a case while an enquiry is being conducted by the Employer the proceedings under the contract would not be stalled.

2.0 Commitments of the Bidder(s)/Contractor(s)

The Bidder(s)/Contractor(s) commits itself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre-contract or post-contract stage in order to secure the contract or in furtherance to secure it and in particular commit itself to the following :-

2.1 The Bidder(s)/Contractor(s) will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the Employer, connected directly or indirectly with the bidding process, or to any person, organization or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation of the contract.

2.2 The Bidder/Contractor further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to

any official of the Employer or otherwise in procuring the Contract or forbearing to do or having done any act in relation to the obtaining or execution of the contract or any other contract with Employer for showing or forbearing to show favour or disfavour to any person in relation to the contract or any other contract with Employer.

2.3 The Bidder(s)/Contractor(s) shall disclose the name and address of agents and representatives and Indian Bidder(s)/Contractor(s) shall disclose their foreign principals or associates.

2.4 The Bidder(s)/Contractor(s) shall disclose the payments to be made by them to agents/brokers or any other intermediary, in connection with this bid/contract

2.5 The Bidder, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payments he has made, is committed to or intends to make to officials of the Employer or their family members, agents, brokers or any other intermediaries in connection with the contract and the details of services agreed upon for such payments.

2.6 The Bidder/Contractor will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

2.7 The Bidder/Contractor will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.

2.8 The Bidder/Contractor shall not use improperly, for purposes of competition or personal gain, or pass on to others, any information provided by the Employer as part of the business relationship, regarding plans, technical proposals and business details, including information contained in electronic data carrier. The Bidder/Contractor also undertakes to exercise due and adequate care lest any such information is divulged.

2.9 The Bidder(s)/Contractor(s) commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.

2.10 The Bidder(s)/Contractor(s) shall not instigate or cause to instigate any third person to commit any of the actions mentioned above.

2.11 If the Bidder/Contractor or any employee of the Bidder/Contractor or any person acting on behalf of the Bidder/Contractor, either directly or indirectly, is a relative of any of the officers of the Employer, or alternatively, if any relative of an officer of the Employer has financial interest/stake in the Bidder(s)/Contractor(s) firm (excluding Public Ltd. Company listed on Stock Exchange), the same shall be disclosed by the Bidder/Contractor at the time of filling of tender.

The term 'relative' for this purpose would be as defined in Section 2(77) of the Companies Act, 2013 (India).

2.12 The Bidder(s)/Contractor(s) shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee of the Employer.

2.13 The Bidder/supplier shall follow all rules and regulations of **India and/or Nepal.**

3.0 Previous Transgression

3.1 The Bidder(s)/Contractor(s) declares that no previous transgression occurred in the last three years immediately before signing of this Integrity Pact, with any other company in any country in respect on any corrupt practices envisaged hereunder or with any Public Sector Enterprise / Government Department in India and in Nepal *(Employer's country).*

3.2 The Bidder agrees that if it makes incorrect statement on this subject, Bidder can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

4.0 Earnest Money (Security Deposit)

The provision regarding Earnest Money/Security Deposit as detailed in the Notice Invitation Tender (NIT)/Instruction to Bidders (ITB) of the tender document is to be referred.

5.0 Sanctions for Violations

5.1 Any breach of the aforesaid provisions by the Bidder/Contractor or any one employed by it or acting on its behalf shall entitle the Employer to take action as per the procedure mentioned in the "**Guidelines on Banning of Business Dealings**" attached as **Annex-A** and initiate all or any one of the following actions, wherever required:-

(i) To immediately call off the pre contract negotiations without assigning any reason or giving any compensation to the Bidder/Contractor. However, the proceedings with the other Bidder(s)/Contractor(s) would continue.

(ii) The Earnest Money Deposit (in pre-contract stage) and/or Security Deposit/Performance Bond (after the contract is Signed) shall stand forfeited either fully or partially, as decided by the Employer and the Employer shall not be required to assign any reason thereof.

(iii) To immediately cancel the contract, if already signed, without giving any compensation to the Contractor. The Bidder/Contractor shall be liable to pay compensation for any loss or damage to the Employer resulting from such cancellation/rescission and the Employer shall be entitled to deduct the amount so

payable from the money(s) due to the Bidder/Contractor.

(iv) To encash the Bank guarantee, in order to recover the dues if any by the Employer, along with interest as per the provision of contract.

(v) To debar the Bidder/Contractor from participating in future bidding processes of Employer, as per provisions of "Guidelines on Banning of Business Dealings" (**Annex-A**), which may be further extended at the discretion of the Employer.

(vi) To recover all sums paid in violation of this Pact by Bidder(s)/Contractor(s) to any middleman or agent or broker with a view to securing the contract.

(vii) In cases where irrevocable Letters of Credit have been received in respect of any contract signed by the Employer with the Bidder/ Contractor, the same shall not be opened/operated.

(viii) Forfeiture of Performance Security in case of a decision by the Employer to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

5.2 The Employer will be entitled to take all or any of the actions mentioned at para 6.1 (i) to (viii) of this Pact also on the Commission by the Bidder/Contractor or any one employed by it or acting on its behalf (whether with or without the knowledge of the Bidder/Contractor), of an offence as defined in Chapter IX of the Indian Penal Code, 1860 or Prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption in Employer's country.

5.3 The decision of the Employer to the effect that a breach of the provisions of this Pact has been committed by the Bidder/Contractor shall be final and conclusive on the Bidder/Contractor. However, the Bidder/Contractor can approach the Independent External Monitor(s) appointed for the purposes of this Pact.

6.0 Independent External Monitor(s)

6.1 The Employer has appointed Independent External Monitor(s) (hereinafter referred to as Monitors) for this Pact.

6.2 The task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.

6.3 The Monitors shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently.

6.4 Both the parties accept that the Monitors have the right to access all the documents relating to the project/procurement, including minutes of meetings. The right to access records should only be limited to the extent absolutely necessary to investigate the issue related to the subject tender/contract.

6.5 As soon as the Monitor notices, or has reason to believe, a violation of this Pact, he will so inform CMD/CEO/MD of Employer and request Employer to discontinue or take

corrective action, or to take other relevant action. The Monitor can in this regard submit non-binding recommendations. Beyond this the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.

6.6 The Bidder(s)/Contractor(s) accepts that the Monitor has the right to access without restriction, to all Project documentation of the Employer including that provided by the Bidder/Contractor. The Bidder/Contractor will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractor(s). The Monitor shall be under contractual obligation to treat the information and documents of the Bidder/Contractor/Subcontractor(s) with confidentiality.

6.7 The Employer will provide to the Monitor sufficient information about all meetings among the parties related to the project provided such meetings could have an impact on the contractual relations between the parties. The parties will offer to the Monitor the option to participate in such meetings as and when required.

6.8 The Monitor will submit a written report to the CMD/CEO/MD of Employer within 10 days from the date of reference or intimation to him by the Employer/Bidder and should the occasion arise, submit proposals for correcting problematic situations.

6.9 The word 'Monitor' would include both singular and plural.

7.0 Facilitation of Investigation

In case of any allegation of violation of any provisions of this Pact or payment of commission, the Employer or its agencies shall be entitled to examine all the documents including the Books of Accounts of the Bidder/Contractor and the Bidder/Contractor shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

8.0 Law and Place of Jurisdiction

This Pact is subject to Nepal's Law. The place of performance and jurisdiction is the Registered Office of the Employer. The arbitration clause provided in the tender document/contract shall not be applicable for any issue/dispute arising under Integrity Pact.

9.0 Other Legal Actions

9.1 The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

9.2 Changes and supplements as well as termination notice need to be made in writing.

9.3 If the Contractor is a partnership or a consortium or a joint venture, this pact must be signed by all partners of the consortium/joint venture.

10.0 Validity

10.1 The validity of this Integrity Pact shall be from date of its signing and extend upto 5 years or the complete execution of the contract to the satisfaction of both the Employer and the Bidder/Contractor/Seller, including warranty period, whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the signing of the contract or six months from the date of opening of price bids, whichever is earlier.

10.2 Should one or several provisions of this Pact turn out to be invalid, the remainder of this Pact shall remain valid. In this case, the parties will strive to come to an agreement to their original intention.

11.0 The Parties hereby sign this Integrity Pact at _____ on _____.

Employer 	Bidder
	(Authorised Person)
Name of the Officer: **Rakesh Singh**	(Name of the Person)
Designation: **CE (P&C)**	Designation
	Place----------
Place: Tumlingtar, nepal	Date----------
Date----------	
Witness1._____	Witness1._____
(Name and address)	(Name and address)
2._____	2._____
(Name and address)	(Name and address)

Annex-A (with Integrity Pact)

GUIDELINES ON BANNING OF BUSINESS DEALINGS

1.0 Introduction

1.1 Employer deals with Agencies viz. parties/ contractors/ suppliers/ bidders, who are expected to adopt ethics of highest standards and a very high degree of integrity, commitments and sincerity towards the work undertaken. It is not in the interest of Employer to deal with Agencies who commit deception, fraud or other misconduct in the tendering process.

1.2 Since banning of business dealings involves civil consequences for an Agency concerned, it is incumbent that adequate opportunity of hearing is provided and the explanation, if tendered, is considered before passing any order in this regard keeping in view the facts and circumstances of the case.

2.0 Scope

2. 1 The Information for Bidders/ Instruction to Bidders/Notice Inviting Tender/Notice Inviting Quotations and even the General Conditions of Contract (GCC) of Employer generally provide that Employer shall have the rights to remove from list of approved suppliers / contractors or to ban business dealings if any Agency has been found to have committed misconduct or fraud or anything unethical not expected from a reputed contractor.

2.2 The procedure of (i) Removal of Agency from the List of approved suppliers / contractors; (ii) Suspension and (iii) Banning of Business Dealing with Agencies, has been laid down in these guidelines.

2.3 These guidelines shall apply to all the Projects/ Power Stations/ Regional Offices/ Liaison Offices of SJVN including its subsidiaries/JVs.

2.4 It is clarified that these guidelines do not deal with the poor performance of the contractors/ Agencies.

2.5 The banning shall be with prospective effect, i.e. future business dealings.

3.0 Definitions

In these Guidelines, unless the context otherwise requires:

i) "**Party / Contractor / Supplier / Bidders**" shall mean and include a public limited company or a private limited company, a joint Venture, Consortium, HUF, a firm whether registered or not, an individual, cooperative society or an association or a group of persons engaged in any commerce, trade, industry, etc. "Party / Contractor/ Supplier / Bidder' in the context of these guidelines is indicated as 'Agency'.

ii) **"Unit" shall** mean the Project/ Power Station/ Regional Office/ Liaison Office.

iii) "**Competent Authority" and 'Appellate Authority'** shall mean the following:

The concerned Director shall be the 'Competent Authority' for the purpose of these guidelines.

CMD, SJVN shall be the 'Appellate Authority' in respect of such cases.

iv) **"Investigating Committee"** shall mean any Officer/Committee appointed by Competent Authority to conduct investigation.

v) **"List of approved Agencies viz Parties / Contractors / Suppliers/Bidders"** shall mean and include list of Parties/ Contractors / Suppliers / Bidders etc if registered with Employer.

4.0 Initiation of Banning / Suspension

Action for banning /suspension business dealings with any Agency shall be initiated by the department responsible for invitation of bids after noticing the irregularities or misconduct on the part of Agency concerned. Besides the concerned department, Vigilance Department of each Unit/ Corporate Vigilance may also be competent to initiate such action.

5.0 Suspension of Business Dealings.

5.1 If the conduct of any Agency dealing with Employer is under investigation, the Competent Authority may consider whether the allegations (under investigation) are of a serious nature and whether pending investigation, it would be advisable to continue business dealing with the Agency. If the Competent Authority, after consideration of the matter including the recommendation of the Investigating Committee, if any, decides that it would not be in the interest to continue business dealings pending investigation, it may suspend business dealings with the Agency. The order of suspension would operate for a period not more than six months and may be communicated to the Agency as also to the Investigating Committee. The Investigating Committee may ensure that their investigation is completed and whole process of final order is over within such period. However, if investigations are not completed in six months time, the Competent Authority may extend the period of suspension by another three months, during which period the investigations must be completed.

5.2 The order of suspension shall be communicated to all Departmental Heads of SJVN including its subsidiaries and JVs and Heads of the Units. During the period of suspension, no business dealing may be held with the Agency.

5.3 As far as possible, the existing contract(s) with the Agency may continue unless the Competent Authority, having regard to the circumstances of the case, decides otherwise.

5.4 If the Agency concerned asks for detailed reasons of suspension, the Agency may be informed that its conduct is under investigation. It is not necessary to enter into correspondence or argument with the Agency at this stage.

5.5 It is not necessary to give any show-cause notice or personal hearing to the Agency before issuing the order of suspension.

6.0 Ground on which Banning of Business Dealings can be initiated:

6.1 If the security consideration, including questions of loyalty of the Agency to Employer so warrants;

6.2 If the director /owner of the Agency, proprietor or partner of the firm, is convicted by a Court of Law for offences involving moral turpitude in relation to its business dealings with the Government or any other public sector enterprises, during the last three years.

6.3 If business dealings with the Agency have been banned by the Department of Power, Government of India and/or Ministry of Energy, Water Resources and Irrigation, Government of Nepal.

6.4 If the Agency has resorted to corrupt, fraudulent practices including misrepresentation of facts;

6.5 If the Agency uses intimidation / threatening or brings undue outside pressure on Employer or its official for acceptance / performances of the job under the contract;

6.6 If the Agency misuses the premises or facilities of Employer, forcefully occupies or damages Employer's properties including land, water resources, forests / trees or tampers with documents/records etc. (Note: The examples given above are only illustrative and not exhaustive. The Competent Authority may decide to ban business dealing for any good and sufficient reason).

7.0 Banning of Business Dealings

7. 1 A decision to ban business dealings with any Agency shall apply throughout SJVN including its subsidiaries/JVs.

7.2 There will be an Investigating Committee consisting of officers not below the rank of AGM/DGM from Indenting Division, Finance, Law and Contracts. Member from department responsible for invitation of bids shall be the convener of the committee. The functions of the committee shall, inter-alia include:

i) To study the report of the unit/division responsible for invitation of bids and decide if a prima-facie case for banning exists, if not, send back the case to the Competent Authority.

ii) To recommend for issue of show-cause notice to the Agency by the concerned unit/division as per clause 9.1.

iii) To examine the reply to show-cause notice and call the Agency for personal hearing, if required.

iv) To submit final recommendations to the Competent Authority for banning or otherwise.

8.0 Removal from List of Approved Agencies - Suppliers/ Contractors, etc.

8.1 If the Competent Authority decides that the charge against the Agency is of a minor nature, it may issue a show-cause notice as to why the name of the Agency should not be removed from the list of approved Agencies - Suppliers / Contractors, etc.

8.2 The effect of such an order would be that the Agency would not be qualified for competing in Open Tender Enquiries or Limited Tender Enquiries till the period

mentioned in the order.

8.3 Past performance of the Agency may be taken into account while processing approval of the Competent Authority for award of the contract.

9.0 Show-cause Notice

9.1 In case where the Competent Authority decides that action against an Agency is called for, a show-cause notice has to be issued to the Agency, Statement containing the imputation of misconduct or misbehavior may be appended to the show-cause notice and the Agency should be asked to submit within 15 days a written statement in its defense.

9.2 If the Agency requests for inspection of any relevant document in possession of Employer, necessary facility for inspection of documents may be provided.

9.3 The Competent Authority may consider and pass an appropriate speaking order:

a) For exonerating the Agency if the charges are not established;
b) For removing the Agency from the list of approved Suppliers / Contactors, etc.
c) For banning the business dealing with the Agency.

9.4 If it decides to ban business dealings, the period for which the ban would be operative may be mentioned.

10.0 Appeal against the Decision of the Competent Authority

10.1 The Agency may file an appeal against the order of the Competent Authority banning business dealing etc. The appeal shall be filed to Appellate Authority. Such an appeal shall be preferred within one month from the date of receipt of the order banning business dealing, etc.

10.2 Appellate Authority would consider the appeal and pass appropriate order which shall be communicated to the Agency as well as the Competent Authority.

11.0 Circulation of the names of Agencies with whom Business Dealings have been banned

i) The concerned unit shall forward the name and details of the Agency(ies) banned to IT&C Division of SJVN's Corporate Office for displaying the same on SJVN website.

ii) Corporate Contracts Department, SJVN shall also forward the name and details of the Agency(ies) banned to the Ministry of Power, GoI besides forwarding the name and details to the contracts/procurement group of all CPSUs of power sector.

FORM OF DECLARATION OF ELIGIBILITY UNDERTAKING (With Integrity Pact)

We, M/s ……hereby certify that we have not been banned/de-listed/ black listed / debarred from business by any PSU / Govt. Department during last 03 (three) years on the grounds mentioned in para 6 of Guidelines on banning of Business dealing.

(Seal & signature of the Authority Signatory of bidder)

***ATTACHMENT-9**
(Refer Sub-clause 13.3(j) of ITB)

FORM OF JOINT VENTURE/CONSORTIUM AGREEMENT

This Joint Venture/Consortium Agreement made and entered into on this ---------- day of ----------, ----------.

BY AND BETWEEN

----------(Name of the Lead Partner) a Company incorporated under the laws of ---------- **(Name of the Country)** with its Head/registered office at ---------- ---------- **(Address of the Head/Registered Office)*** and a place of business in ---------- ---------- **(Address of place of business) hereinafter referred to as "The Lead Partner" which expression unless otherwise repugnant hereto includes its successors, administrators, and permitted assigns thereof,** represented by **Mr. ---------- ---------- (Name of Authorized signatory(ies).**

AND

----------(Name of the other Partner) a Company incorporated under the laws of ---------- **(Name of the Country)** with its Head/registered office at ---------- ---------- **(Address of the Head/Registered Office)*** and a place of business in --------- ---------- **(Address of place of business) hereinafter referred to as Partner-1 which expression unless otherwise repugnant hereto includes its successors, administrators, and permitted assigns thereof**, represented by Mr. ---------- **(Name of Authorized signatory (ies).**

All and/or each of them hereinafter referred to as "the Parties".

WITNESSETH

WHEREAS SAPDC Pvt. Ltd. (hereinafter referred to as "The Employer") has issued Invitation vide NIT No. ---------- dated ----------

for the execution of Package no. _____ of _____ H.E. Project **(hereinafter referred to as "the works").** The Employer intends to invite bids from eligible Bidders for Domestic Competitive Bidding (DCB) in respect of the above works.

WHEREAS the Parties are interested in jointly preparing and submitting a Bid to qualify, for the Project as a loose knit Joint venture/Consortium.

Article 1.0 PURPOSE OF THIS AGREEMENT

1.1 The purpose of this Agreement is to define the principles of collaboration among the Parties to:

**** Strike out which is not applicable.***

- Submit a Bid jointly to qualify for the execution of Package no. _____ of _____ H.E. Project as a loose-knit Joint venture/Consortium.
- Prepare and submit technical and commercial proposals to the Employer, if invited by Employer.
- Negotiate and sign Contract in case of award.
- Provide and perform the Works in accordance with the Contract.

1.2 NAME

For the purpose of participating in the Bid, the name of the Consortium/Joint Venture shall be "_____".

Article 2.0 LEGAL RELATIONSHIP OF THE MEMBERS

2.1 This Agreement shall not be construed as establishing or giving effect to any legal entity such as, but not limited to, a company, a partnership, etc. It shall relate solely towards the Employer for Package no. _____ of _____ H.E. Project and related execution works to be performed pursuant to the Contract and shall not extend to any other activities.

2.2 The Parties shall be jointly and severally responsible and bound towards the Employer for the performance of the works in accordance with the terms and conditions of the Bid document and/or Contract.

Article 3.0 LEADERSHIP

---------- (Name of the Lead Partner) shall act as Leader of the Joint Venture/Consortium. As such, it shall act as the coordinator of the Party's combined activities and shall carry out the following functions:

3.1 To ensure the technical, commercial and administrative co-ordination of the Project.

3.2 To lead the contract negotiations of the Works with the Employer.

3.3 The Lead partner is authorized to receive instructions and incur liabilities for and on behalf of any or all Parties.

3.4 In case of an award, act as channel of communication between the Employer and the Parties to execute the Contract

3.5 Responsible for overall performance of the contract.

Article 4.0 SCOPE OF WORKS AND SERVICES OF EACH PARTY

The Scope of works to be performed by each Party shall be as herein below:

4.1 **Scope of Works and Services:**

The Scope of Work and services for each Party shall be defined as follows:

4.1.1 …… (**Name of Lead Partner**) shall be responsible for the following (Define the scope of works):-

-
-
-

4.1.2 …… (**Name of Other Partner**) shall be responsible for the following (Define the scope of works):-

-
-
-

4.2 Participation Share of each Partner

Lead Partner	……. %
1st Partner	……. %

4.3 Capital Contribution to be made by each Party for the Works

Lead Partner	……. %
1st Partner	……. %

4.4 Financial Commitment of each Party in terms of Contract Value

Lead Partner	……. %
1st Partner	……. %

4.5 Sharing of Profit and Loss by each Party

Lead Partner	……. %
1st Partner	……. %

The payments shall be made in the name of _____(Name of Joint Venture/ Consortium as appearing in Article 1.2 above).

Article 5.0 SECURITIES

Securities in the form of Bank Guarantees, required under the Bid document and/or Contract shall be provided in the name of individual partner of Joint Venture/Consortium in proportion of its participation share. In case of Indian JV partner or Indian contractor, the Bank Guarantee shall be acceptable only if these are issued by Scheduled Bank of India to be confirmed by a "A" Class Bank in Nepal.

Article 6.0 LIABILITY

6.1 LIABILITY OF THE PARTIES WITH RESPECT TO CLAIMS OF THE EMPLOYER

The Parties shall be jointly and severally liable to the Employer for the Performance of the work under the terms of the Contract.

6.2 In case there is dispute between the parties to the Joint Venture; the same shall not affect the work of the Employer.

Article 7.0 DURATION OF THE AGREEMENT

7.1 This Agreement is valid until end of Defect Notification Period of the Contract and full and final settlement of all accounts and disputes, if any, between the Parties and the Employer, except

a) if the Employer has decided previously not to award the Contract to the Parties, or

b) if one of the parties is declared bankrupt,

in which case the Parties are free from any obligation under this Agreement.

7.2 The Joint Venture Agreement shall not be terminated by the parties without the written consent of the Employer.

IN WITNESS WHEREOF, this agreement executed on the _____day of _____ (month) 20____ by the duly authorized representatives of the parties hereto.

For and on behalf of M/s _____
(Lead Partner)

Name:

Seal:

For and on behalf of M/s _____
(Partner-1)
Name:

Seal:

NOTARY

* Joint Venture/Consortium Agreement (attested by Notary Public) and signed between the Partner(s) of JV/C as per above format shall be submitted alongwith the Bids of the Bidders.

(Refer Sub-clause 1.6 of GCC)

2. FORM OF AGREEMENT

AGREEMENT

This agreement is made on _____ day of _____ Two Thousand ------- between the …….., registered and existing under the Laws of Nepal and having its registered Office at …….(hereinafter referred to as the "Employer" which expression shall unless repugnant to the context or meaning thereof include its successors and assigns) of the one part and M/s _____ registered under the _____ Act and having its principal / registered office at _____(herein after called "the Contractor" which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) of the other part.

WHEREAS the Employer is desirous that certain Works should be executed by the Contractor, viz: Package _____ **HE Project,** _____and has accepted the Bid of the Contractor for the execution and completion of such Works and the remedying of any defects therein at the cost of ` ------- (Rupees----------).

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz:

   i) the Letter of Acceptance;
   ii) the Letter of Tender and the Appendix to Bid;
   iii) the Particular Conditions of the Contract,
   iv) the General Conditions of the Contract (FIDIC), First Edition 1999,
   v) the Technical Specifications
   vi) the Tender Drawings;
   vii) the priced Bill of Quantities;
   viii) Data Sheets;
   ix) Information for Bidders;
   x) any other documents forming part of the Contract.

3. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy the defects therein in conformity in all respect in accordance with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the works and remedying of defects therein the Contract Price or such other sum as may become payable under the provisions of the Contract at the time and in the manner prescribed by the Contract.

In Witness whereof the parties hereto have caused this Agreement to be executed the day and year first before written, at ---------- (name of place).

The Common Seal of_____

was hereunto affixed in the presence of:

For and on behalf of the Contractor	For and on behalf of SAPDC Pvt. Limited
Signature----------	Signature----------
(Designation)----------	(Designation)----------
Place:	Place:
Witnessed by:	Witnessed by:
1.-Name & Address	1. Name & Address
2. Name & Address	2. Name & Address

3. PERFORMANCE SECURITY FORM

(Refer Sub-clause 35 of ITB)

(To be submitted by the Contractor)

Bank Guarantee

(To be stamped in accordance with Stamp Act
if any, of the Country of the Issuing Bank)

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

To,
[Employer's Name & Address]

Dear Sirs,

In consideration of the ... *[Employer's Name]*..... (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) having awarded to M/s .....*[Contractor's Name]*..... with its Registered/Head Office at ..... (hereinafter referred to as the 'Contractor', which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns), a Contract by issue of Employer's Letter of Acceptance No..... dated..... and the same having been acknowledged by the Contractor, for ----------[Contract sum in figures and words] for ……*[Name of the work]* and the Contractor having agreed to provide a Contract Performance Guarantee for the faithful performance of the entire Contract equivalent to .....(*).....of the said value of the aforesaid work under the Contract to the Employer.

We .....*[Name & Address 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 Employer, on demand any and all monies payable by the Contractor to the extent of .....(*)..... as aforesaid at any time upto .....(@)..... *[days/month/year]* without any demur, reservation, contest, recourse or protest and/or without any reference to the Contractor. Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Bank undertakes not to revoke this guarantee during its currency without previous consent of the Employer and further agrees that the guarantees herein contained shall continue to be enforceable till the Employer discharges this guarantee or till ……(+)…….. *[days/month/year]* whichever is earlier.

(**)

The Employer 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. The Employer 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, 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 Employer and the Contractor or any other course or remedy or security available to the Employer. The Bank shall not be released of its obligations under these presents by any exercise by the Employer 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 Employer or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under the law would, but for this provision have the effect of relieving the Bank.

The Bank also agrees that the Employer 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 and notwithstanding any security or other guarantee the Employer may have in relation to the Contractor's liabilities.

i) Our liability under this Bank Guarantee shall not exceed _____(*)_____.

ii) This Bank Guarantee shall be valid upto _____(+)_____.

iii) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if Employer serves upon Bank a written claim or demand on or before _____(@)_____

Dated this .....day of .....20_.....at.....

WITNESS

..... (Signature).....

(Signature)

.....

(Name) (Name).....

....

(Official Address) (Designation with Bank Stamp)/with staff Authority no.

Complete Address
of the Bank with Tele-Fax

Notes :1. (*) This sum shall be three percent (3%) of the Contract Price denominated in the types and proportions of currencies.

(@) This date will be Ninety (90) days beyond the issue of Defects liability Certificate as specified in the Contract.

(**) Employer may also present any of his demands at the counters of the .....*(Name and branch of the Bank in Nepal)*..... for further relay to

us. *(To be inserted in case of a foreign currency bank guarantee issued by a bank outside Nepal)*

(+) This date will be the date of issue of Defects Liability Certificate.

2. Bank guarantee should contain rubber stamp of the authorized signatory of the bank indicating the name, designation and signature/ power of attorney number as well as telephone/ fax numbers with full correspondence address of the Bank.

Bank Guarantee in NPR should be executed on letter head of the "A" class commercial Bank. The issuing Bank shall be requested independently for verification/confirmation of the Bank Guarantee issued, non confirmation of which may lead to rejection of 'Bid Security. *The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal.*

3. The issuing bank shall write the name of bank's controlling branch/ Head Office along with contact details like telephone/ fax and full correspondence address in order to get the confirmation of BG from that branch/ Head office, if so required.

4. PERFORMANCE SECURITY BANK GUARANTEE

(Refer Sub-clause 35 of ITB)

(To be submitted by Subcontractor)

(To be stamped in accordance with Stamp Act
if any, of the Country of the Issuing Bank)

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

To,
[Employer's Name & Address]

Dear Sirs,

In consideration of the ... *[Employer's Name]*..... (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) having awarded to M/s .....*[Contractor's Name]*..... with its Registered/Head Office at ..... (hereinafter referred to as the 'Contractor', which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns), a Contract by issue of Employer's Letter of Acceptance No..... dated..... and the same having been acknowledged by the Contractor, for ----------[Contract sum in figures and words] for ……*[Name of the work]* and the Contractor alongwith M/s…,*[Subcontractor's Name]* a Company with Registered Office at ……(hereinafter referred to as the 'Subcontractor' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) having executed a Deed of Undertaking for successful performance of the component works to be executed by the Subcontractor and the Subcontractor having agreed to provide an additional Contract Performance Guarantee for the faithful performance of the sub-let works under the Contract equivalent to 5%(five percent) of the value of the aforesaid sub-let works under the Contract to the Employer.

We .....*[Name & Address 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 Employer, on demand any and all monies payable by the Contractor to the extent of .....(*)..... as aforesaid at any time upto .....(@)..... *[days/month/year]* without any demur, reservation, contest, recourse or protest and/or without any reference to the Contractor. Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Bank undertakes not to revoke this guarantee during its currency without previous consent of the Employer and further agrees that the guarantees herein contained shall continue to be enforceable till the Employer discharges this guarantee or till ……(+)…….. *[days/month/year]* whichever is earlier.

(**)

The Employer 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 Subcontractor. The Employer 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 Subcontractor, 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 Employer and the Contractor or Deed of Undertaking executed by the Contractor alongwith its Subcontractor any other course or remedy or security available to the Employer. The Bank shall not be released of its obligations under these presents by any exercise by the Employer 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 Employer or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under the law would, but for this provision have the effect of relieving the Bank.

The Bank also agrees that the Employer 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 Subcontractor and notwithstanding any security or other guarantee the Employer may have in relation to the Contractor's liabilities.

i) Our liability under this Bank Guarantee shall not exceed _____(*)_____.

ii) This Bank Guarantee shall be valid upto _____(+)_____.

iii) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if Employer serves upon Bank a written claim or demand on or before _____(@)_____

Dated this .....day of .....(month).....(year) .....at.....

WITNESS

..... (Signature).....

(Signature)

.....

(Name) (Name).....

....

(Official Address) (Designation with Bank Stamp)/Staff Authority No.

Complete Address of the Bank with Tele-Fax.

Notes :1. (*) This sum shall be three percent (3%) of the value of the sub-let works as identified in the Contract denominated in the types and proportions of currencies.

(@) This date will be Ninety (90) days beyond the date of completion of the part of the Works to be executed by the Subcontractor.

(**) Employer may also present any of his demands at the counters of the .....*(Name and branch of the Bank in Nepal)*..... for further relay to us. *(To be inserted in case of a foreign currency bank guarantee issued by a bank outside Nepal)*

(+) This date will be the date of issue of Taking Over Certificate.

2. The name of the purchaser should appear at the back side of stamp paper in the Vendors Stamp. Bank guarantee should contain rubber stamp of the authorized signatory of the bank indicating the name, designation and signature/ power of attorney number as well as telephone/ fax numbers with full correspondence address of the Bank.

   Bank Guarantee in NPR should be executed on letter head of the "A" class commercial Bank. The issuing Bank shall be requested independently for verification/confirmation of the Bank Guarantee issued, non confirmation of which may lead to rejection of 'Bid Security. *The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal.*

3. The issuing bank shall write the name of bank's controlling branch/ Head Office along with contact details like telephone/ fax and full correspondence address in order to get the confirmation of BG from that branch/ Head office, if so required.

5. PERFORMANCE SECURITY FORM

(Refer Sub-clause 35 of ITB)

(To be submitted by the Partners of Joint Venture)

Bank Guarantee

(To be stamped in accordance with Stamp Act
if any, of the Country of the Issuing Bank)

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

To,
[Employer's Name & Address]

Dear Sirs,

In consideration of the ... *[Employer's Name]*..... (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators and assigns) having awarded to M/s .....*[Contractor's Name]*..... with its Registered/Head Office at ..... (hereinafter referred to as the 'Contractor', which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns), a Contract by issue of Employer's Letter of Acceptance No..... dated..... and the same having been acknowledged by the contractor, for ----------[Contract sum in figures and words] for ……*[Name of the work]* and the Contractor having agreed to provide a Contract Performance Guarantee in the name of individual partner of JV in proportion of their participation share in JV for the faithful performance of the entire Contract equivalent to .....(*).....of the said value of the aforesaid work under the Contract to the Employer.

We .....*[Name & Address 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 Employer, on demand any and all monies payable by the Contractor to the extent of .....(*)..... as aforesaid at any time upto .....(@)..... *[days/month/year]* without any demur, reservation, contest, recourse or protest and/or without any reference to the Contractor (individual partners in case of JV). Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Bank undertakes not to revoke this guarantee during its currency without previous consent of the Employer and further agrees that the guarantees herein contained shall continue to be enforceable till the Employer discharges this guarantee or till ……(+)…….. *[days/month/year]* whichever is earlier.

(**)

The Employer 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 (individual partners in case of JV). The Employer 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, 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 Employer and the Contractor or any other course or remedy or security available to the Employer. The Bank shall not be released of its obligations under these presents by any exercise by the Employer 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 Employer or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under the law would, but for this provision have the effect of relieving the Bank.

The Bank also agrees that the Employer 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 (individual partners in case of JV) and notwithstanding any security or other guarantee the Employer may have in relation to the Contractor's (individual partner's in case of JV) liabilities.

i) Our liability under this Bank Guarantee shall not exceed _____(*)_____.

ii) This Bank Guarantee shall be valid upto _____(+)_____.

iii) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if Employer serves upon Bank a written claim or demand on or before _____(@)_____

Dated this .....day of .....(month).....(year) .....at.....

WITNESS

..... (Signature).....

(Signature)

.....

(Name) (Name).....

....

(Official Address) (Designation with Bank Stamp)/Staff Authority No.

Complete Address of the Bank with Tele-Fax

Notes :1. (*) This sum shall be three percent (3%) in proportion of the participation share of the partner in the Joint Venture totaling to five percent of the Contract Price denominated in the types and proportions of currencies.

(@) This date will be Ninety (90) days beyond the issue of Defects liability Certificate as specified in the Contract.

(**) Employer may also present any of his demands at the counters of the .....*(Name and branch of the Bank in Nepal)*..... for further relay to us. *(To be inserted in case of a foreign currency bank guarantee issued by a bank outside Nepal)*

(+) This date will be the date of issue of Defects Liability Certificate.

2. Bank guarantee should contain rubber stamp of the authorized signatory of the bank indicating the name, designation and signature/ power of attorney number as well as telephone/ fax numbers with full correspondence address of the Bank.

   Bank Guarantee in NPR should be executed on letter head of the "A" class commercial Bank. The issuing Bank shall be requested independently for verification/confirmation of the Bank Guarantee issued, non confirmation of which may lead to rejection of 'Bid Security. *The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal.*

3. The issuing bank shall write the name of bank's controlling branch/ Head Office along with contact details like telephone/ fax and full correspondence address in order to get the confirmation of BG from that branch/ Head office, if so required.

(Refer Sub-clause 14.2 of GCC)

6. BANK GUARANTEE FOR ADVANCE PAYMENT

(To be executed on letter head of the Bank)

(To be stamped in accordance with Stamp Act
if any, of the Country of the Issuing Bank)

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

To,
[Employer's Name & Address]
Dear Sir,

In consideration of the *[Employer's Name]*..... (hereinafter referred to as the 'Employer', which expression shall, unless repugnant to the context or meaning thereof include its successors, administrators and assigns) having awarded to M/s.....*[Contractor's Name]*..... with its Registered/Head Office at ..... (hereinafter referred to as the 'Contractor' which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns), a Contract, by issue of Employer's Letter of Acceptance No. ..... dated ..... and the same having been acknowledged by the Contractor, resulting into a Contract bearing No. .....dated.....valued at..... ……for .....*[Name of Contract*] .....(hereinafter called the 'Contract') and the Employer having agreed to make an advance payment to the Contractor for performance of the above Contract amounting ..... (in words and figures) as an Advance against Bank Guarantee to be furnished by the Contractor.

We.....*[Name and address 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 Employer, immediately on demand any or, all monies payable by the Contractor to the extent of .....*[advance amount]*..... as aforesaid at any time upto .....(@)..... without any demur, reservation, contest, recourse or protest and/ or without any reference to the Contractor. Any such demand made by the Employer on the Bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor 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 Employer discharges this guarantee. This guarantee may be progressively reduced by amount repaid by the contractor.

(**)

The Employer 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 to extend the time for performance of the Contract by the Contractor. The Employer 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, 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 Employer and the Contractor or any other course or remedy or security available to the Employer. The Bank shall not be released of its obligations under these presents by any exercise by the Employer 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 Employer or any other indulgence shown by the Employer 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 Employer 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 and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

Notwithstanding anything contained herein:

i) Our liability under this Bank Guarantee shall not exceed._____.

ii) This Bank Guarantee shall be valid upto _____.

iii) We are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if Employer serve upon Bank a written claim or demand on or before_____(@)_____

Dated this ..... day of .....(month).....(year)..... at ..... .

WITNESS

..... (Signature).....
(Signature)

.....
(Name) (Name).....

....
(Official Address)

(Designation with Bank Stamp)/Staff Authority No.

Complete Address of the Bank with Tele-Fax

Dated.....

Notes: 1. (@) This date shall be ninety (90) days beyond the date of Completion of the Works.

(**) Employer may also present any of his demands at the counters of the .....*(Name and branch of the Bank in Nepal)*.....for further relay to us.

(To be inserted in case of a foreign currency bank guarantee issued by a bank outside Nepal)

2. The name of the purchaser should appear at the back side of stamp paper in the Vendors Stamp. Bank guarantee should contain rubber stamp of the authorized signatory of the bank indicating the name, designation and signature/ power of attorney number as well as telephone/ fax numbers with full correspondence address of the Bank.

   Bank Guarantee in NPR should be executed on letter head of the "A" class commercial Bank. The issuing Bank shall be requested independently for verification/confirmation of the Bank Guarantee issued, non confirmation of which may lead to rejection of 'Bid Security. *The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal.*

3. The issuing bank shall write the name of bank's controlling branch/ Head Office along with contact details like telephone/ fax and full correspondence address in order to get the confirmation of BG from that branch/ Head office, if so required.

7. FORM OF TAKING OVER CERTIFICATE

Date: _____

[*Name of Contract]*

To: *[Name and address of Contractor]*

Dear Sir,

Pursuant to General **Conditions of the Contract, Clause- 10 *(Taking Over Certificate)*** of the Conditions of the Contract entered into between yourselves and the Employer dated *[date]*, relating to the *[brief description of the Works]*, following part(s) of the Works was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part(s) of the Works, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below.

1. Description of the Works or part thereof: *[description]*

2. Date of Completion: *[date]*

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Works in accordance with the Contract nor of your obligations during the Defects Liability Period.

Very truly yours,

Title
(Engineer)

(Refer Sub-clause 14.9 of GCC)

8. BANK GUARANTEE FORM FOR RELEASE / PAYMENT OF RETENTION MONEY

(To be stamped in accordance with Stamp Act
if any, of the Country of the Issuing Bank)

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

To,
[Employer's Name & Address]

1. We.....*[Name and address of the Bank]* ..... having our Registered/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 undertake and agree to indemnify and keep indemnified the……..*[Employer's Name]* ……..... (hereinafter referred to as "the Employer " which expression shall, unless repugnant to the subject or context, include its administrators, successors and assigns), to the extent of .....*[amount]*..... on behalf of M/s.....*[Contractor's Name]*..... with its Registered/Head Office at ..... (hereinafter referred to as "the Contractor) in lieu of an equal cash amount of Retention Money deposited by the Contractor and/or deducted by the Employer from the bills of the Contractor and which the Employer has agreed to substitute with a bank guarantee as hereunder, under the provisions of Contract No.....dt. ….....which the Contractor has entered into with the Employer in connection with the construction of.....…. (*Name of Work*) at a total cost of..... (*Contract Sum)* (hereinafter called the ` Contract').

2. We, the Bank also do hereby agree to pay unequivocally and unconditionally within 48 hours on demand, in writing, from the Employer, of any amount upto and not exceeding .....*[amount]*..... to the Employer for any purpose or cause or on any account whatsoever under the provisions of the Contract in which respect the decision of the Employer shall be final and binding on us.

   (**)

3. Provided that it shall not be necessary for the Employer to proceed against the Contractor before proceeding against us and the guarantee herein contained shall be enforceable against us, notwithstanding any security which the Employer may have obtained or obtain from the Contractor shall, at the time when proceedings are taken against us as hereunder, be outstanding or unrealised.

4. We, the Bank, further agree that this guarantee shall be valid and binding on us upto and including .....(@).....and shall not be terminable by notice or any change in the constitution of the said Bank or the Contractor or by any other reasons whatsoever and our liability hereunder shall not be impaired or discharged by any extension of time or variations made, given conceded, or agreed with or without our knowledge or consent, by or between the parties to the Contract.

5. We also undertake not to revoke this guarantee during its currency except with the previous consent, in writing, of the Employer.

6. Our liability under this guarantee is restricted to ……..*[amount]*..... Our guarantee shall remain in force until .....(@) .....unless a suit or action to enforce a claim under the guarantee is filed against us within 90 days from that date, all your rights under this guarantee shall be forfeited and we shall be relieved and discharged from all liabilities thereunder:

In the presence of

Witness For and on behalf of the Bank

..... Bank's common seal

Dated this.....day of .....(month)……..(year)

The above Guarantee is accepted by the Corporation

For and on behalf of the Corporation

Signature.....

Name and designation.....

Name of Project/Unit.....

Date.....

Notes:

1. (@) The last date of Defects Notification Period.

   (**) Employer may also present any of his demands at the counters of the.....*(Name and branch of the Bank in Nepal)*.....for further relay to us. *(To be inserted in case of a foreign currency bank guarantee issued by an overseas bank outside Nepal)*

2. Bank guarantee should contain rubber stamp of the authorized signatory of the bank indicating the name, designation and signature/ power of attorney number as well as telephone/ fax numbers with full correspondence address of the Bank.

   Bank Guarantee in NPR should be executed on letter head of the "A" class commercial Bank. The issuing Bank shall be requested independently for verification/confirmation of the Bank Guarantee issued, non confirmation of which may lead to rejection of 'Bid Security. *The Bank Guarantees in INR shall be acceptable only if these are issued by a Scheduled Bank of India duly counter guaranteed by any A class bank in Nepal.*

3. The issuing bank shall write the name of bank's controlling branch/ Head Office along with contact details like telephone/ fax and full correspondence address in order to get the confirmation of BG from that branch/ Head office, if so required.

9. HINDRANCE REGISTER

Name of Project:----------

1.Name of Work:----------

2.Agreement No.:----------

3.Executing Agency:----------

Sl No	Nature/Reason of Hindrance	Item /Component of works which could not be executed on account of this Hindrance	Date of start of Hindrance	Date of removal of Hindrance	Overlapping Period (if any)	Net Hindrances in days	Signature of Engineer 's Representative	Signature of the Contractor	Remarks
1	2	3	4	5	6	7	8	9	10

Bill of Quantities

Volume-3, Section-5

PREAMBLE

1. General Principle

The Bill of Quantities is to be read in conjunction with all the other documents comprising the bid documents.

2. Definitions

(i) 'Works' includes work to be carried out, goods, materials and services to be supplied, and the liabilities, obligations and risks to be undertaken by the contractor under the contract.
(ii) 'Supply' shall be deemed to include delivery to the site, loading and unloading at stores unless expressly stated otherwise.

3. Arrangement of the Bill of Quantities

3.1 Description

Description will identify the work covered by the respective items, but the nature and extent of the work is to be ascertained from and shall be in accordance with the relevant sections of the Technical Specifications.

3.2 Quantities

The quantities inserted in the BOQ are, wherever possible, computed from the bid drawings. They have been rounded up or down wherever appropriate. The contractor must recognize that the quantities in BOQ/schedule represent estimated quantities subject to the variations on each item during detailed engineering, and no claim beyond the contract provisions shall be made for deficiency or overrun therein actual or relative.

4. Completion and Pricing of the Bill of Quantities

4.1 Insertion of Rates and Prices

In inserting rates and prices in the Bill of Quantities, the contractor thereby agrees to perform the relevant items of work at those rates and prices and declares that every rate and price which he submits;

(i) Has been delivered in a reasonable fashion.
(ii) Properly reflects the cost of doing the portion of the work to which that price or unit price pertains.
(iii) Is inclusive of everything necessary to perform and complete in accordance with the bid documents that portion of the work to which the price or unit price pertains including, but not limiting to all supervision, labour, maintenance, equipment, supplies, materials,

facilities, overhead, profit and contingent expenses of every kind except as otherwise specifically provided for in the bid documents.

5. Relationship to Other Documents

(i) The various prices and rates to be inserted in the Bill of Quantities are together to be the full inclusive value of the work described, including all costs and expenses which may be required in and for the construction of the work described, together with all risks, liabilities and obligations set forth or implied in the bid documents.

(ii) General directions and descriptions of work and materials given elsewhere are not necessarily repeated in the Bill of Quantities and reference is to be made to the drawings, specifications, and other relevant documents for this information.

(iii) Operations listed in a scheduled rate are generally listed only where it is felt necessary to differentiate between the content of a number of items, each of which covers a different part of a whole process. The use of the word 'including' within the BOQ may be taken to highlight a particular operation but shall not mean that no other operations need to include in the rate. It follows that no claim for additional payment will be considered if based merely on the proposition that not all necessary operations within any item are included in any description or discussion. Thus, all necessary operations listed in or implied by the Specifications, drawings including supply, handling and fixing will be deemed to be included in the rates irrespective of whether some, all or none are specifically mentioned in the Bill of Quantities.

(iv) Rates shall always include for testing except where testing is scheduled separately for payment.

6. Rates and Prices of Items

(i) In case for any item(s) appearing in the BOQ, no rate or prices have been entered, the same will be executed by contractor at no cost to the employer. Revision of rate(s) shall however be available in accordance with provision of contract, in case deviated quantities exceed beyond variation limit and the item become eligible for revision of rates in term of provision of contract.

List of Abbreviations

Derived Quantity	Name	Symbols
Length	millimeter	mm
	centimeter	cm
	metre	m
	kilometer	km
Area	square millimeter	mm^2
	square centimeter	cm^2
	square meter	m^2
Volume	cubic meter	m^3
Mass	kilogram	kg
	Tonne/Ton	t
	Metric ton	MT
Density	ton per cubic meter	t/m^3
Stress	Newton per square millimeter	N/mm^2
	Kilo-Newton per square millimeter	kN/mm^2
Pressure	bar	bar
	Pascal	Pa
	Mega-Pascal	MPa
Time	Second	s
	Hour	hr
Rate of Flow	liters per second or minute	l/s, l/min
	Cubic meter per second	m^3/s
	Cubic meter per minute	m^3/min

Velocity	meter per second	m/s
Speed of rotation	revolution per minute	rpm
Temperature	degree Celsius	°C
Energy	Kilowatt hour	kWh
Slope	Vertical: horizontal	v: h
Gradient	Percentage (Vertical: horizontal)	%
	Lump Sum	LS

ARUN-3 HEP (900 MW)
PACKAGE C-7 SECTION-A
BILL OF QUANTITIES FOR TAIL RACE POND AND OUTFALL

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
1-OPEN EXCAVATION 1.1	CHAPTER-5	IV	Loose excavation and ripping in open cuts and in foundations of structures in all types of soils and depositing the excavated materials in regular layers with necessary levelling and stockpiling the useful materials separately as and where directed with all lifts and lead up to 1 km.	m3	61250				
1.2	CHAPTER-5	IV	Excavation in rock in open cuts and in foundations of structures including depositing the excavated materials in regular layers with necessary levelling and stockpiling the useful materials separately as and where directed with all lifts and lead up to 1 km	m3	115000				
1.3	CHAPTER-5	IV	Dental excavation (in open cuts, for foundations of structures, clay bands, in faults and seams, etc.).	m3	400				
1.4	CHAPTER-5	IV	Removal of slips, bluffs and loose rock i.e. loading, handling , dumping of material and cleaning of surface and depositing the excavated materials in regular layers with necessary levelling and stockpiling the useful materials separately as and where directed with all lifts and lead up to 1 km.	m3	5000				
1.5	CHAPTER-5	IV	Hauling of excavated materials for actual distance beyond 1 km from site of excavation.	m3 x km	550000				
1.6	CHAPTER-5	IV	Shoring and strutting the excavated surface including labour, materials, fabrication, erection and removal.	m2	300				
2-BACKFILL 2.1	CHAPTER-5	V	Backfilling the excavated portions with materials of approved quality including excavating ,transporting and placing in layers watering and compacting with all leads and lifts.	m3	3500				
3-ROCKBOLTS & ANCHORS 3.1	CHAPTER-8	II	Providing and installing 32mm dia. grouted expansion shell type rock bolts with all accessories and fittings including stressing and load testing complete in all respects, upto 8m length.	m	200				
3.2	CHAPTER-8	II	Providing and installing 32mm dia. resin grouted type rock bolts with all accessories and fittings including filling with quickset and slow set resin cartridges, stressing and load testing complete in all respects, upto 8m length.	m	250				
3.3	CHAPTER-8	II	Providing and installing 32mm dia. grouted anchor bars including cutting , bending, grouting and testing complete in all respects, upto 8m length	m	6330				

ARUN-3 HEP (900 MW)
PACKAGE C-7 SECTION-A
BILL OF QUANTITIES FOR TAIL RACE POND AND OUTFALL

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
3.4	CHAPTER-8	II	Providing and installing 32mm dia. grouted anchor bars including cutting , bending, grouting and testing complete in all respects, more than 8m length	m	7170				
3.5	CHAPTER-8	II	Providing and installing miscellaneous metal pieces such as small steel beams, steel plates, steel cables used in conjunction with rock bolts complete in all respects.	MT	2				
3.6	CHAPTER-8	II	Providing and installing prestressed rock anchors (tendon/cable anchors) of 40 MT capacity including drilling,staging, grouting, stressing and load testing complete in all respects.	m	900				
3.7	CHAPTER-8	II	Providing and installing welded wiremesh including overlaps and all necessary accessories for fixing such as steel pins, mesh pins, extra plates and nuts for fastening to rock bolts complete in all respects.	MT	1.5				
4-SHOTCRETE 4.1	CHAPTER-9	III	Production, supply and application of shotcrete as per mix design including preparation and cleaning of surfaces, placing of plug gauges for control of layer thickness and removal of rebound, temporary protection and curing including admixtures and but excluding reinforcement with 10mm maximum aggregate size.	m3	50				
4.2	CHAPTER-9	III	Production, supply and application of Steel Fibre Reinforced Shotcrete (SFRS) as per mix design including preparation and cleaning of surfaces, placing of plug gauges for control of layer thickness and removal of rebound, temporary protection and curing including admixtures and but excluding reinforcement with10mm maximum aggregate size.	m3	500				
5-STEEL REINFORCEMENT 5.1	CHAPTER-10	II	Providing and fixing HYSD steel reinforcement for R.C.C. works including supply, handling, storage, cutting, bending and placing.	MT	3760				
6-FORMWORK 6.1	CHAPTER-11	V	Providing and erecting formwork for plane surfaces including maintenance, oiling, all necessary ties and fixing, access scaffoldings, forming for chamfers up to 500mm either internal or external and edges up to 50mm width, F 1	m2	6500				

ARUN-3 HEP (900 MW)
PACKAGE C-7 SECTION-A
BILL OF QUANTITIES FOR TAIL RACE POND AND OUTFALL

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
6.2	CHAPTER-11	V	Providing and erecting formwork for plane surfaces including maintenance, oiling, all necessary ties and fixing, access scaffoldings, forming for chamfers up to 500mm either internal or external and edges up to 50mm width, F 2	m2	2300				
6.3	CHAPTER-11	V	Providing and erecting formwork for plane surfaces including maintenance, oiling, all necessary ties and fixing, access scaffoldings, forming for chamfers up to 500mm either internal or external and edges up to 50mm width, F 3	m2	460				
6.4	CHAPTER-11	V	Providing and erecting formwork for curved surfaces including maintenance, oiling, all necessary ties and fixing, access scaffoldings, forming for chamfers up to 500mm either internal or external and edges up to 50mm width, F3C	m2	120				
7-DRILLING & GROUTING 7.1	CHAPTER-12	V	Drilling holes for 32mm dia Rock bolts and Anchor Bars vertical or inclined in all formations of rock/Concrete by percussion drilling, upto 8m depth	m	6780				
7.2	CHAPTER-12	V	Drilling holes for 32mm dia Rock bolts and Anchor Bars vertical or inclined in all formations of rock/Concrete by percussion drilling, more than 8m depth	m	7170				
7.3	CHAPTER-12	V	Drilling pressure relief holes /drainage holes of 76 mm diameter vertical or inclined in all formations of rock/concrete by percussion drilling.	m	100				
7.4	CHAPTER-12	V	Drilling 76 mm dia drainage holes, providing and laying PVC perforated pipes in the holes and filling with gravel.	m	1375				
7.5	CHAPTER-12	V	Drilling holes of minimum 45mm diameter vertical or inclined in all formations rock/concrete for curtain grouting by percussion drilling.	m	500				
7.6	CHAPTER-12	V	Drilling holes of minimum 38 mm diameter vertical or inclined in all formations of rock/concrete for consolidation grouting, draining of rock and water pressure testing by percussion drilling	m	1500				
7.7	CHAPTER-12	V	ODEX drilling (min 100mm dia., pipe and sleeve method) for grouting overburden material.	m	2580				

ARUN-3 HEP (900 MW)
PACKAGE C-7 SECTION-A
BILL OF QUANTITIES FOR TAIL RACE POND AND OUTFALL

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
7.8	CHAPTER-12	V	Drilling holes with triple tube core barrel diamond drilling machine in underground/open work areas for exploration, draining of rock and instrumentation with or without core recovery - Nx hole: 89 mm (outer),76mm (inner)	m	100				
7.9	CHAPTER-5	V	Drilling of holes 38 mm to 45 mm diameter by line drilling	m	1200				
7.10	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Consolidation grouting in single stage in holes drilled from surface or from the underground	Per hole	60				
7.11	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Consolidation grouting in multiple stage in holes drilled from surface or from the underground	Per hole	262				
7.12	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Fill grouting of exploratory holes where directed by the Engineer.	Per hole	4				
7.13	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Curtain grouting in holes drilled from the surface or from the underground.	Per hole	34				
7.14	CHAPTER-12	V	Water pressure testing of holes	Per hole	10				
7.15	CHAPTER-12	III	Cement used for grouting including provision, delivery, transportation, storage and complying with all specified requirements	MT	2900				
7.16	CHAPTER-12	V	Sand used for grouting with average natural water content as approved by the Engineer.	MT	725				
7.17	CHAPTER-12	V	Bentonite used for grouting with average natural water content as approved by the Engineer.	MT	290				
7.18	CHAPTER-12	V	Admixtures used for grouting including supply, handling, storage and dispersing.	kg	29000				

ARUN-3 HEP (900 MW)
PACKAGE C-7 SECTION-A
BILL OF QUANTITIES FOR TAIL RACE POND AND OUTFALL

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
7.19	CHAPTER-12	I	Standard mild steel pipes and fittings used for grouting and left permanently in rock and concrete including supply installation and protection against blockage of pipes and fittings.	kg	3000				
7.20	CHAPTER-12	v	PVC pipes ± 50mm dia. To be placed in drill holes(minimum 100 mm dia.) for grouting by Odex drilling.	m	2580				
8-CONCRETE 8.1	CHAPTER-13	III	Providing and laying cement concrete of M-10 grade with graded crushed aggregates including preparing surfaces, mixing, placing, vibrating, curing and finishing complete for all leads and lifts.	m3	16500				
8.2	CHAPTER-13	III	Providing and laying cement concrete of M-15 grade with graded crushed aggregates including preparing surfaces, mixing, placing, vibrating, curing and finishing complete for all leads and lifts.	m3	8000				
8.3	CHAPTER-13	III	Providing and laying cement concrete of the M-20 grade with graded crushed aggregates including preparing surfaces, mixing, placing, vibrating, curing and finishing complete for all leads and lifts.	m3	1800				
8.4	CHAPTER-13	III	Providing and laying cement concrete of M-25 grade with graded crushed aggregates including preparing surfaces, mixing, placing, vibrating, curing and finishing complete for all leads and lifts.	m3	23500				
8.5	CHAPTER-13	III	Providing and laying second stage concrete of M-30 grade in block outs including preparation of contact surfaces with parent concrete and furnishing of non shrink agents.	m3	132				
8.6	CHAPTER-13	V	Air entraining and water reducing/set controlling or any other approved admixtures/additives/ accelerators used for different grades of concrete, established at trial mix stages including supply, handling, storage and dispersing.	kg	37197				
9- MASONRY WORK 9.1	CHAPTER-16	III	Random rubble masonry with hard stone of approved quality including racking out joints in cement mortar 1:6 (1cement: 6 approved sand) for all leads and lifts and curing complete as per drawings or as directed by the Engineer.	m3	260				

ARUN-3 HEP (900 MW)
PACKAGE C-7 SECTION-A
BILL OF QUANTITIES FOR TAIL RACE POND AND OUTFALL

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
9.2	CHAPTER-16	V	Supply and Placing of Mechanically Woven Double Twisted Hexagonal shaped wire mesh Gabion Boxes of required sizes, Mesh Type 8cm x10cm, Zinc coated Mesh wire dia. 3.0 mm, edges of meshes mechanically selvedged with wire dia. 3.9 mm, heavy coating of galvanization as per IS 16014:2012, stitching with lacing wire of dia. 2.2 mm @ 3% by weight of gabion boxes. with partition at 1m interval and properly packed with 150-300 mm size boulders including transportation and placing at indicated places as per drawing or directed by Engineer including contractor's tools, labours, etc. complete in all respect.	m3	3000				
9.3	CHAPTER-16	V	Stone filling, dry, hand packed of selected hard stone behind retaining walls/abutments etc. as per drawings or as directed by the Engineer.	m3	700				
9.4	CHAPTER-16	V	Providing and laying dry stone pitching of selected hard stone, hand packed on sloping faces or other areas as per requirements and drawings or as directed by the Engineer.	m3	250				
9.5	CHAPTER-16	V	Providing turfing in dumping areas with Geo-green erosion control blanket including but not limited to preparation of surface, mixing of grass seeds with topsoil, laying geo green erosion control blanket, supply and planting of the seeds and tree species etc. complete in all respect as per scope of work provided in Technical Specification	m2	2556				
10-MISCELLANEOUS METALWORKS 10.1	CHAPTER-13	I	Installing/embedding in concrete/rock first stage embedment for gates, gate hoists, other control equipments and anchor bolts etc.	MT	1				
10.2	CHAPTER-23	I	Providing and fixing steel stairs/hand rails/platforms as shown on drawings or as directed by Engineer including supply, handling, storage, cutting, welding, testing and fabrication including painting complete, in all respects.	kg	6600				
11-WATERSTOPS 11.1	CHAPTER-13	V	Providing and fixing in position PVC waterstops of 300mm width including lapping/Vulcanising and joining	m	260				
11.2	CHAPTER-13	V	Providing and fixing in position bitumen sheet or any other filler material in expansion and contraction joints.	m2	100				
11.3	CHAPTER-13	V	Providing and applying joint sealing compound in expansion/contraction joints	m	400				

ARUN-3 HEP (900 MW)
PACKAGE C-7 SECTION-A
BILL OF QUANTITIES FOR TAIL RACE POND AND OUTFALL

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
11.4	CHAPTER-13	V	Painting of surfaces of expansion and contraction joints with bituminous paint in three layers	m2	400				
FIXED RATE ITEMS									
12.2	CHAPTER-14	V	Dewatering by pumping in surface construction Sites (measured in terms of electric energy consumed by dewatering pumps) using electric pumps including design of dewatering system, excavation of drainage trenches and sumps, providing, installation and removal of all pumps, sumps, supply, installation and removal of pipe lines and other accessories, moving of pumps and pipes to different locations and operation and maintenance of dewatering system. The pumps and other accessories shall remain contractors property after the use.	kWH	20000				
Total									

ARUN-3 HEP (900MW)
PACKAGE C-7, SECTION-B
BILL OF QUANTITIES FOR INTAKE STRUCTURE

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
1. OPEN EXCAVATION 1.1	CHAPTER-5	IV	Loose excavation and ripping in open cuts and in foundations of structures in all types of soils and depositing the excavated materials in regular layers with necessary levelling and stockpiling the useful materials separately as and where directed with all lifts and lead up to 1 km.	m3	4235				
1.2	CHAPTER-5	IV	Excavation in rock in open cuts and in foundations of structures including depositing the excavated materials in regular layers with necessary levelling and stockpiling the useful materials separately as and where directed with all lifts and lead up to 1 km	m3	7865.00				
1.3	CHAPTER-5	IV	Removal of slips, bluffs and loose rock i.e. loading, handling , dumping of material and cleaning of surface and depositing the excavated materials in regular layers with necessary levelling and stockpiling the useful materials separately as and where directed with all lifts and lead up to 1 km.	m3	212				
1.4	CHAPTER-5	IV	Hauling of excavated materials for actual distance beyond 1 km from site of excavation.	m3x km	39899				
1.5	CHAPTER-5	V	Shoring and strutting the excavated surface including labour, materials, fabrication, erection and removal.	m2	100				
2. BACKFILL 2.1	CHAPTER-5	V	Backfilling the excavated portions with materials of approved quality including excavating ,transporting and placing in layers watering and compacting with all leads and lifts.	m3	500				
3. UNDERGROUND EXCAVATION 3.1	CHAPTER-6	IV	Excavation in tunneling by conventional method of drill and blast, providing arrangements for lighting and ventilation, transporting the excavated material and depositing it in regular layers with necessary leveling and stockpiling the useful material as and where directed, with all lifts and lead up to 1 km. from portal in all types of rock classes except extremely poor rock class.	m3	3000				
3.2	CHAPTER-6	IV	Additional rate over and above item no. 3.1 for excavation in tunneling in power intake by mechanical means like twin cutter, road header etc. in all types of rock classes except extremely poor rock class.	m3	300				

ARUN-3 HEP (900MW)
PACKAGE C-7, SECTION-B
BILL OF QUANTITIES FOR INTAKE STRUCTURE

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
3.3	CHAPTER-6	IV	Removal of fallen material from approved overbreak including loading, hauling, dumping of material and cleaning of surface with all lifts and lead up to 1 km from portal.	m3	240				
3.4	CHAPTER-6	IV	Hauling of excavated materials for actual distance beyond 1 km from portal .	m3x km	13138				
4. STRUCTURAL STEEL SUPPORT 4.1	CHAPTER-7	I	Supply, handling, fabrication, transportation to the place of installation and installation of steel ribs, tie rods, foot plates, foot blocks, bolts, nuts etc.	MT	20				
4.2	CHAPTER-7	III	Providing and fixing precast reinforced concrete panels of grade M-15 as lagging including steel reinforcement.	m3	60				
5. ROCKBOLTS & ANCHORS 5.1	CHAPTER-8	II	Providing and installing 32mm dia. resin grouted type rock bolts with all accessories and fittings including filling with quickset and slow set resin cartridges, stressing and load testing complete in all respects, upto 8m length.	m	1350				
5.2	CHAPTER-8	II	Providing and installing 32mm dia. grouted anchor bars including cutting, bending, grouting and testing complete in all respects, upto 8m length.	m	1120				
5.3	CHAPTER-8	II	Providing and installing 32mm dia. grouted anchor bars including cutting, bending, grouting and testing complete in all respects, more than 8m length.	m	1510				
5.4	CHAPTER-8	II	Providing and installing miscellaneous metal pieces such as small steel beams, steel plates, steel cables used in conjunction with rock bolts complete in all respects.	MT	1				
5.5	CHAPTER-8	II	Drilling, supply and installing 32mm dia. self drilling type anchors with all accessories and fittings including grouting and load testing, upto 8m length.	m	100				
5.6	CHAPTER-8	II	Providing and installing prestressed rock anchors (tendon/cable anchors) of 40 MT capacity including drilling,staging, grouting, stressing and load testing complete in all respects.	m	100				
5.7	CHAPTER-8	II	Providing and installing welded wiremesh and all necessary accessories for fixing such as steel pins, mesh pins, extra plates and nuts for fastening to rock bolts complete in all respects.	MT	0.50				

ARUN-3 HEP (900MW)
PACKAGE C-7, SECTION-B
BILL OF QUANTITIES FOR INTAKE STRUCTURE

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
6. SHOTCRETE 6.1	CHAPTER - 9	III	Production, supply and application of shotcrete as per mix design including preparation and cleaning of surfaces, placing of plug gauges for control of layer thickness and removal of rebound, temporary protection and curing including admixtures and but excluding reinforcement with 10mm maximum aggregate size.	m3	25				
6.2	CHAPTER - 9	III	Production, supply and application of Steel Fibre Reinforced Shotcrete (SFRS) as per mix design including preparation and cleaning of surfaces, placing of plug gauges for control of layer thickness and removal of rebound, temporary protection and curing including admixtures and but excluding reinforcement with10mm maximum aggregate size.	m3	125				
7. STEEL REINFORCEMENT 7.1	CHAPTER - 10	II	Providing and fixing HYSD steel reinforcement for R.C.C. works including supply, handling, storage, cutting, bending and placing.	MT	896				
8. FORMWORK 8.1	CHAPTER -11	V	Providing and erecting formwork for plane surfaces including maintenance, oiling, all necessary ties and fixing, access scaffoldings, forming for chamfers up to 500mm either internal or external and edges up to 50mm width, F 1	m2	2200				
8.2	CHAPTER -11	V	Providing and erecting formwork for plane surfaces including maintenance, oiling, all necessary ties and fixing, access scaffoldings, forming for chamfers up to 500mm either internal or external and edges up to 50mm width, F 3	m2	950				
8.3	CHAPTER -11	V	Providing and erecting formwork for curved surfaces including maintenance, oiling, all necessary ties and fixing, access scaffoldings, forming for chamfers up to 500mm either internal or external and edges up to 50mm width, F3C	m2	3600				
9. DRILLING & GROUTING 9.1	CHAPTER - 12	V	Drilling holes for 32mm dia Rock bolts and Anchor Bars vertical or inclined in all formations of rock/Concrete by percussion drilling, upto 8m depth.	m	2470				
9.2	CHAPTER - 12	V	Drilling holes for 32mm dia Rock bolts and Anchor Bars vertical or inclined in all formations of rock/Concrete by percussion drilling, more than 8m depth.	m	1510				

ARUN-3 HEP (900MW)
PACKAGE C-7, SECTION-B
BILL OF QUANTITIES FOR INTAKE STRUCTURE

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
9.3	CHAPTER - 12	V	Drilling holes of minimum 38 mm diameter vertical or inclined in all formations of rock/concrete for contact grouting.	m	10				
9.4	CHAPTER - 12	V	Drilling holes of minimum 38 mm diameter vertical or inclined in all formations of rock/concrete for consolidation grouting, draining of rock and water pressure testing by percussion drilling	m	90				
9.5	CHAPTER - 12	V	Drilling 76 mm dia drainage holes, providing and laying PVC perforated pipes in the holes and filling with gravel.	m	250				
9.6	CHAPTER - 12	V	Drilling pressure relief holes/drainage holes of minimum 76 mm diameter vertical or inclined in all formations of rock/concrete by percussion drilling.	m	50				
9.7	CHAPTER - 5 & 6	V	Drilling of holes 38 mm to 45 mm diameter by line drilling	m	300				
9.8	CHAPTER - 12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Contact grouting in single stage between rock and concrete for backfilling the voids created by approved geological overbreaks except the crown.	Per Hole	30				
9.9	CHAPTER - 12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Consolidation grouting in single stage in holes drilled from surface or from the underground	Per hole	30				
9.10	CHAPTER - 12	V	Water pressure testing of holes	Per hole	5				
9.11	CHAPTER - 12	III	Cement used for grouting including provision, delivery, transportation, storage and complying with all specified requirements	MT	90				
9.12	CHAPTER - 12	V	Sand used for grouting with average natural water content as approved by the Engineer.	MT	23				
9.13	CHAPTER - 12	V	Bentonite used for grouting with average natural water content as approved by the Engineer.	MT	9				
9.14	CHAPTER - 12	V	Admixtures used for grouting including supply, handling, storage and dispersing.	kg	900				

ARUN-3 HEP (900MW)
PACKAGE C-7, SECTION-B
BILL OF QUANTITIES FOR INTAKE STRUCTURE

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
9.15	CHAPTER - 12	I	Standard mild steel pipes and fittings used for grouting and left permanently in rock and concrete including supply installation and protection against blockage of pipes and fittings.	kg	400				
10. CONCRETE (OPEN & UNDERGROUND) 10.1	CHAPTER - 13	III	Providing and laying cement concrete of M-10 grade with graded crushed aggregates including preparing surfaces, mixing, placing, vibrating, curing and finishing complete for all leads and lifts.	m3	1000				
10.2	CHAPTER - 13	III	Providing and laying cement concrete of M-15 grade with graded crushed aggregates including preparing surfaces, mixing, placing, vibrating, curing and finishing complete for all leads and lifts.	m3	280				
10.3	CHAPTER - 13	III	Providing and laying cement concrete of M-25 grade with graded crushed aggregates including preparing surfaces, mixing, placing, vibrating, curing and finishing complete for all leads and lifts.	m3	6050				
10.4	CHAPTER - 13	III	Providing and laying second stage concrete of M-30 grades in block outs including preparation of contact surfaces with parent concrete and furnishing of non shrink agents.	m3	42				
10.5	CHAPTER - 13	III	Providing and laying backfill concrete of grade M10 behind steel/precast concrete lagging and beyond pay line in approved over break including form works and in additional excavation ordered by the Engineer including form work.	m3	120				
10.6	CHAPTER - 13	III	Providing and laying cement concrete of M-25 grades placed in tunnel overt lining including design, furnishing, maintenance, erection and removal of steel formwork, mixing and placing of concrete, vibrating, curing and finishing complete for all leads and lifts, contact grouting in the crown, sealing of cracks and cold joints etc.	m3	630				
10.7	CHAPTER - 13	III	Providing and laying cement concrete of grade M-30 placed in tunnel invert lining including preparing surfaces, laying cement slurry before placing concrete, mixing, placing, vibrating, curing and finishing complete for all leads and lifts & form work if any.	m3	300				

ARUN-3 HEP (900MW)
PACKAGE C-7, SECTION-B
BILL OF QUANTITIES FOR INTAKE STRUCTURE

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
10.8	CHAPTER - 13	V	Air entraining and water reducing/set controlling or any other approved admixtures/additives/accelerators used for different grades of concrete, established at trial mix stages including supply, handling, storage and dispersing.	kg	9717				
11. MISCELLANEOUS METALWORKS 11.1	CHAPTER-13	I	Installing/embedding in concrete/rock first stage embedment for gates, gate hoists, other control equipments and anchor bolts etc.	MT	0.50				
11.2	CHAPTER-23	I	Providing and fixing steel stairs/hand rails/platforms as shown on drawings or as directed by Engineer including supply, handling, storage, cutting, welding, testing and fabrication etc. complete in all respects.	kg	2800				
FIXED RATE ITEMS									
12.2	CHAPTER -14	V	Dewatering by pumping in underground construction Sites (measured in terms of electric energy consumed by dewatering pumps) using Electric Pumps including design of dewatering system, excavation of drainage trenches and sumps, providing, installation and removal of all pumps, sumps, supply, installation and removal of pipe lines and other accessories, moving of pumps and pipes to different locations and operation and maintenance of dewatering system. The pumps and other accessories shall remain contractor's property after the use.	kWh	2200				
Total									

ARUN-3 HEP (900 MW)
PACKAGE C-7, SECTION-C
BILL OF QUANTITIES FOR HEAD RACE TUNNEL FROM STATION 0.00 m TO 100.00 m

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
1. UNDERGROUND EXCAVATION 1.1	CHAPTER-6	IV	Excavation in tunnelling in HRT by conventional method of drill and blast, providing arrangements for lighting and ventilation, transporting the excavated material and depositing it in regular layers with necessary levelling and stockpiling the useful material as and where directed with all lifts and lead upto 1 km from portal in all types of rock classes except extremely poor rock class.	m^3	10950				
1.2	CHAPTER-6	IV	Excavation in tunneling in extremely poor rock class including lighting and ventilation arrangements, transporting the excavated material and depositing it in regular layers with necessary leveling and stockpiling the useful material as and where directed with all lifts and lead up to 1 km from portal.	m^3	600				
1.3	CHAPTER-6 &2	IV	Additional rate for excavation in tunneling under geo-thermal conditions when the values of underground temperatures and water inflow (both or either) exceed 50 degree Celsius and water inflow is more than 120 litres/sec. respectively.	m^3	116				
1.4	CHAPTER-6	IV	Additional excavation in any type of rock wherever required by the Engineer including lighting and ventilation arrangements, transporting the excavated material and depositing it in regular layers with necessary leveling and stockpiling the useful material as and where directed with all lifts and lead up to 1 km from portal.	m^3	100				
1.5	CHAPTER-6	IV	Additional rate over and above item no. 1.1 for excavation in tunneling by mechanical means like twin cutter, road header etc. in all types of rock classes except extremely poor rock class.	m^3	548				
1.6	CHAPTER-6	IV	Removal of fallen material from approved overbreak including loading, hauling, dumping of material and cleaning of surface with all lifts and lead up to 1 km from portal.	m^3	693				

ARUN-3 HEP (900 MW)
PACKAGE C-7, SECTION-C
BILL OF QUANTITIES FOR HEAD RACE TUNNEL FROM STATION 0.00 m TO 100.00 m

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
1.7	CHAPTER-6	IV	Hauling of excavated materials for actual distance beyond 1 km from portal.	m^3 x km	40000				
2. STRUCTURAL STEEL SUPPORT 2.1	CHAPTER-7	I	Supply, handling, fabrication, transportation to the place of installation and installation of steel ribs, tie rods, foot plates, foot blocks, bolts, nuts etc.	MT	40				
2.2	CHAPTER-7	III	Providing and fixing precast reinforced concrete panels of grade M-15 as lagging including steel reinforcement.	m^3	146				
2.3	CHAPTER-7	I	Supply, handling, fabrication, transportation to the place of installation and installation of miscellaneous metal pieces including props, invert struts and cross bracings etc.	MT	7				
2.4	CHAPTER-7	I	Supply, handling, fabrication, transportation to the place of installation and installation of steel lagging.	MT	2				
2.5	CHAPTER-7	I	Supply, handling, fabrication, transportation to the place of installation and installation of lattice girders, foot plates, props, foot blocks, placer bars, bolts, nuts and all other accessories.	MT	2				
3. ROCKBOLTS & ANCHORS 3.1	CHAPTER-8	II	Providing and installing 32mm dia. grouted anchor bars including cutting , bending, grouting and testing complete in all respects, upto 8m length	m	564				
3.2	CHAPTER-8	II	Providing and installing 25 mm dia resin grouted type rock bolts with all accessories and fittings including filling with quickset and slow set resin cartridges, stressing and load testing complete in all respects, up to 8m length.	m	2000				
3.3	CHAPTER-8	II	Providing and installing 32 mm dia resin grouted type rock bolts with all accessories and fittings including filling with quickset and slow set resin cartridges, stressing and load testing complete in all respects, up to 8m length.	m	2500				

ARUN-3 HEP (900 MW)
PACKAGE C-7, SECTION-C
BILL OF QUANTITIES FOR HEAD RACE TUNNEL FROM STATION 0.00 m TO 100.00 m

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
3.4	CHAPTER-8	II	Providing and installing miscellaneous metal pieces such as small steel beams, steel plates, steel cables used in conjunction with rock bolts complete in all respects.	MT	1				
3.5	CHAPTER-8	II	Drilling, supply and installing 32mm dia self drilling type anchors with all accessories and fittings including grouting and load testing, up to 8m length.	m	100				
3.6	CHAPTER-8	II	Supply, providing, and installing 25-32 mm diameter up to 5m long ungrouted bar spiles into pre-drilled holes including cutting and fixing in position, drilling holes complete in all respects.	MT	2				
3.7	CHAPTER-8	I	Supply,providing and installing 80- 114 mm diameter upto 12 m long forepoling pipes including drilling complete in all respects.	MT	8				
3.8	CHAPTER-8	II	Providing and installing welded wiremesh including overlaps and all necessary accessories for fixing such as steel pins, mesh pins, extra plates and nuts for fastening to rock bolts complete in all respects.	MT	0.5				
4. SHOTCRETE 4.1	CHAPTER-9	III	Production, supply and application of shotcrete as per mix design including preparation and cleaning of surfaces, placing of plug gauges for control of layer thickness and removal of rebound, temporary protection and curing including admixtures and but excluding reinforcement with 10mm maximum aggregate size.	m^3	25				
4.2	CHAPTER-9	III	Production, supply and application of Steel Fibre Reinforced Shotcrete (SFRS) as per mix design including preparation and cleaning of surfaces, placing of plug gauges for control of layer thickness and removal of rebound, temporary protection and curing including admixtures and but excluding reinforcement with 10mm maximum aggregate size.	m^3	220				

ARUN-3 HEP (900 MW)
PACKAGE C-7, SECTION-C
BILL OF QUANTITIES FOR HEAD RACE TUNNEL FROM STATION 0.00 m TO 100.00 m

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
5. STEEL REINFORCEMENT 5.1	CHAPTER-10	II	Providing and fixing HYSD steel reinforcement for R.C.C. works including supply, handling, storage, cutting, bending and placing.	MT	60				
6. DRILLING & GROUTING 6.1	CHAPTER-12	V	Drilling holes for 25 mm dia. Rock bolts and Anchor Bars vertical or inclined in all formations of rock/Concrete by percussion drilling, up to 8m depth.	m	2000				
6.2	CHAPTER-12	V	Drilling holes for 32 mm dia. Rock bolts and Anchor Bars vertical or inclined in all formations of rock/Concrete by percussion drilling, up to 8m depth.	m	3064				
6.3	CHAPTER-12	V	Drilling holes of minimum 38 mm diameter vertical or inclined in all formations of rock/concrete for contact grouting.	m	70				
6.4	CHAPTER-12	V	Drilling holes of minimum 38 mm diameter vertical or inclined in all formations of rock/concrete for consolidation grouting, draining of rock and water pressure testing by percussion drilling	m	680				
6.5	CHAPTER-12	V	Drilling holes of minimum 45mm diameter vertical or inclined in all formations rock/concrete for curtain grouting by percussion drilling.	m	35				
6.6	CHAPTER-12	V	Drilling 76 mm dia drainage holes, providing and laying PVC perforated pipes in the holes and filling with gravel.	m	51				
6.7	CHAPTER-12	V	Drilling pressure relief holes/drainage holes of minimum 76 mm diameter vertical or inclined in all formations of rock/concrete by percussion drilling.	m	24				
6.8	CHAPTER-12	V	Drilling holes with triple tube core barrel diamond drilling machine in underground/open work areas for exploration, draining of rock and instrumentation with or without core recovery- N_x hole: 89 mm (outer), 76mm (inner)	m	50				
6.9	CHAPTER-12	V	Drilling for drainage/exploratory holes 76 mm dia., (upto 24 m long).	m	20				

ARUN-3 HEP (900 MW)
PACKAGE C-7, SECTION-C
BILL OF QUANTITIES FOR HEAD RACE TUNNEL FROM STATION 0.00 m TO 100.00 m

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
6.10	CHAPTER-6	V	Drilling of holes 38 mm to 45 mm diameter by line drilling	m	500				
6.11	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Contact grouting in single stage between rock and concrete for backfilling the voids created by approved geological overbreaks except the crown.	Per Hole	102				
6.12	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Fill grouting for filling the temporary drainage system in underground works including the provision of any standpipes, block outs or extra drilling work required.	m	26				
6.13	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Fill grouting of exploratory holes where directed by the Engineer.	Per Hole	5				
6.14	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Consolidation grouting in single stage in holes drilled from surface or from the underground.	Per hole	36				
6.15	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for Consolidation grouting in multiple stage in holes drilled from surface or from the underground.	Per hole	54				

ARUN-3 HEP (900 MW)
PACKAGE C-7, SECTION-C
BILL OF QUANTITIES FOR HEAD RACE TUNNEL FROM STATION 0.00 m TO 100.00 m

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
6.16	CHAPTER-12	V	Placing grout including labour, equipment, processing, mixing, hooking up to the hole, injecting grout, hole closures and clearing up, excluding cost of cement, sand, bentonite, admixtures and chemicals for curtain grouting in holes drilled from the surface or from the underground.	Per hole	4				
6.17	CHAPTER-12	V	Water pressure testing of holes	Per hole	2				
6.18	CHAPTER-12	III	Cement used for grouting including provision, delivery, transportation, storage and complying with all specified requirements	MT	270				
6.19	CHAPTER-12	V	Sand used for grouting with average natural water content as approved by the Engineer.	MT	68				
6.20	CHAPTER-12	V	Bentonite used for grouting with average natural water content as approved by the Engineer.	MT	27				
6.21	CHAPTER-12	V	Admixtures used for grouting including supply, handling, storage and dispersing.	kg	2700				
6.22	CHAPTER-12	I	Standard mild steel pipes and fittings used for grouting and left permanently in rock and concrete including supply installation and protection against blockage of pipes and fittings.	kg	257				
7-CONCRETE 7.1	CHAPTER-13	III	Providing and laying backfill concrete of grade M10 behind steel/precast concrete lagging and beyond pay line in approved over break including form works and in additional excavation ordered by the Engineer including form work.	m^3	633				
7.2	CHAPTER-13	III	Providing and laying cement concrete of M-25 grade placed in tunnel overt lining including design, furnishing, maintenance, erection and removal of steel formwork, mixing and placing of concrete, vibrating, curing and finishing complete for all leads and lifts, contact grouting in the crown, sealing of cracks and cold joints etc.	m^3	1397				

ARUN-3 HEP (900 MW)
PACKAGE C-7, SECTION-C
BILL OF QUANTITIES FOR HEAD RACE TUNNEL FROM STATION 0.00 m TO 100.00 m

Item No.	Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rate (NPR)	Unit Rate (INR)	Amount (NPR)	Amount (INR)
7.3	CHAPTER-13	III	Providing and laying cement concrete of grade M-25 placed in tunnel invert lining including preparing surfaces, laying cement slurry before placing concrete, mixing, placing, vibrating, curing and finishing complete for all leads and lifts & form work if any.	m^3	466				
7.4	CHAPTER-13	V	Installing the pressure relief valves in concrete as shown on the drawings or as directed by the Engineer.	No.	10				
7.5	CHAPTER-13	V	Air entraining and water reducing/set controlling or any other approved admixtures/additives/accelerators used for different grades of concrete, established at trial mix stages including supply, handling, storage and dispersing.	kg	2708				
8-WATERSTOPS 8.1	CHAPTER-13	V	Providing and fixing in position PVC waterstops of 300 mm width including lapping/Vulcanising and joining	m	72				
FIXED RATE ITEMS									
9.2	CHAPTER-14	V	Dewatering by pumping in underground construction Sites (measured in terms of electric energy consumed by dewatering pumps) using electric pumps including design of dewatering system, excavation of drainage trenches and sumps, providing, installation and removal of all pumps, sumps, supply, installation and removal of pipe lines and other accessories, moving of pumps and pipes to different locations and operation and maintenance of dewatering system. The pumps and other accessories shall remain contractors property after the use.	kWh	3000				
Total									

BOQ for Fixed Rate Item 'Cement Variation' (for Section-A, Section-B & Section-C of BOQ)

Reference to Technical Specifications	Category in terms of Clause 13.8 of GCC/PCC	Description of Work	Unit	Quantity	Unit Rates in figures (INR)	Unit Rates in words (INR)
CHAPTER-13	III	Additional rate/reduction rate for difference in the cement contents of the original concrete mix(s) on which the bid price has been based and the mix(s) finalized after trial mix stage.	kg	-		

Notes:

1. **The bidder(s) shall duly fill in, sign and stamp this part of BOQ and upload the scanned copy of same under Part II in Item tab on portal https://etender.sjvn.co.in/SRMLogin/SRMLogin.jsp only.**
2. **The bidder shall fill in rates and prices for all other items of the Works described in the Bill of Quantities (except for items of *'Cement variation'*) on portal https://etender.sjvn.co.in/SRMLogin/SRMLogin.jsp directly.**
3. **Any indication of BOQ/price schedules or/and Fixed Rate Items in Part-I of bid shall lead to outrightly rejection of bid.**
4. **The above item of 'Cement Variation' shall not be considered for evaluation.**

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CHAPTER – 1

INTENT OF TECHNICAL SPECIFICATIONS

INDEX

1.1 General

(i) These specifications are part of the requirements for various items related to the work which are to be provided according to the stipulations of the contract. Hence, the instructions given herein form an integral part of, and are applicable to the Contract documents issued for the works. Addendum to these specifications may be issued, as required, during bidding and construction phases.

(ii) These specifications shall be read in conjunction with the conditions of contract, the bid drawings and the bill of quantities (BOQ). The contractor shall comply with all provisions contained in the Contract documents and instructions of the Engineer.

(iii) It is the intent of these specifications, together with other relevant documents issued as part of the Contract documents to follow later on and to provide the contractor with complete and detailed information and subsequent instructions necessary to enable him to submit a well planned bid, to carry out the designs, where and when required, and to execute properly the work prescribed.

(iv) It is the intent of these specifications to establish acceptable standards of quality. Minor deviations in details due to manufacturer's standard shop process will be considered for acceptance provided that, in the opinion of the Engineer, the proposed substitutions are equivalent in quality to those specified.

(v) All works shall be executed according to the construction drawings and other requirements issued for construction, in a professional and diligent manner and all supplies and works shall comply with the quality requirements defined in the relevant chapters of these specifications and other Contract documents. Bid drawings are only for general idea and estimation of quantity of the works. The contractor shall endeavour to provide all such necessary efforts in order to comply with the intent of these specifications to the satisfaction of the Engineer.

1.2 Submittals

(i) The contractor shall provide to the Engineer at least three copies or as otherwise specified, of all submittals as requested for in these Specifications and other Contract documents. They shall be complete enough to illustrate clearly the problem of the aspect concerned for the understanding of the Engineer and shall conform to the requirement of the Engineer.

(ii) At any time, the Engineer may call either for additional information, completion of the submittals or request the contractor not to submit some of them.

(iii) The contractor shall submit these documents to the Engineer so that, even if not specifically expressed, reasonable time is available to the Engineer to comment upon or approve the submittals.

1.3 Standards and Codes

1.3.1 General

(i) All works shall conform to the Indian Standards or those specified in the Contract documents.

(ii) All standards and codes referred to shall be the latest current issues.

(iii) In case of discrepancies between these specifications and National or International Standards and Codes, these Specifications being part of Contract documents shall govern, unless otherwise directed by the Engineer in each particular case.

(iv) Two complete set of standards and codes adopted/to be adopted for the works shall be submitted free of charge by the contractor to the Engineer, immediately after the contract has come in to force or upon the Engineer's request. Such copies shall also be available at the contractor's business domicile(s) and at site, for use of the Engineer.

1.3.2 National Standards, Codes, Laws and Regulations

(i) Throughout the duration of the contract, the materials, equipment, services, design and workmanship shall conform to the applicable National Codes, Indian Standards, or those specified in the bid documents, Laws and Regulations in force in that region, if not otherwise specified.

(ii) It is the contractor's duty to acquaint himself with all National Codes, Standards, laws and regulations related to the works in any way and he shall procure and keep on the site a copy of each of such applicable documents which are relevant to work to be performed at that site.

1.3.3 International Standards and Codes

(i) The International Standards/Codes may be adopted provided that;

(a) The Standards/Codes proposed are at least as stringent as the equivalent Indian ones relevant to the works, or if there is no applicable Indian Standards/Codes for the specific item concerned.

(b) The contractor prior to starting the works shall state the International Standard/Code he proposes to apply, giving full identification of each of them. Decision to allow use of notified Standards/Codes rests with the Engineer.

(ii) Where reference is made in the Contract documents to the Standards/Codes of the country of origin for a supply item, it shall be a recognized National Standard/Code of the country where the specific supply item is manufactured. To be acceptable under these specifications, such Standards/Codes must comply in all respects with the quality requirements of above mentioned Standards/Codes and must be approved by the Engineer.

1.4 Unit(s) of Measurement

Measurement of an item shall be done in the reasonable unit practicable for measurement of quantity of such item as decided by Engineer and payment made for the actual quantity so measured. For illustration purpose only, the rate of an item may be per tonne. The measurement for payment of quantity of such an item may be done in kg as may be feasible and practicable.

1.5 Completeness of Item

Unless provided in the contract, the cost of all incidental, ancillary and any other item of work which are not specifically mentioned in the contract but are considered necessary to complete a certain item of work, shall be deemed to be included in the unit rate(s) of respective items of work. Any replacement/repair of damaged work and removal of defects, unless occurred due to instruction of Engineer, shall be carried out by the contractor at no cost to the Employer.

1.6 System of Units

(i) The SI system of Units has been used throughout these specifications and this system of units shall be used consequently throughout the duration of contract for all technical or contractual purposes.

(ii) Following abbreviations/symbols shall be used in these specifications and other related contract documents.

Derived Quantity	Name	Symbols
Length	millimeter	mm
	centimeter	cm
	meter	m

	kilometer	km
Area	square millimeter square centimeter square meter	mm^2 cm^2 m^2
Volume	cubic meter	m^3
Mass	kilogram	kg
	Tonne/Ton	t
	Metric ton	MT
Density	ton per cubic meter	t/m^3
Stress	Newton per square millimeter	N/mm^2
	Kilo-Newton per square millimeter	kN/mm^2
Pressure	bar	bar
	Pascal	Pa
	Mega-Pascal	MPa
Time	Second	s
	Hour	hr
Rate of Flow	liters per second or minute	l/s, l/min
	Cubic meter per second	m^3/s
	Cubic meter per minute	m^3/min
Velocity	meter per second	m/s
Speed of rotation	revolution per minute	rpm
Temperature	degree Celsius	°C
Energy	Kilowatt hour	kWh

Slope	Vertical: horizontal	v: h
Gradient	Percentage (Vertical: horizontal)	%
	Lump Sum	LS
	Water-Cement Ratio	W/C

CHAPTER – 2

SITE INSTALLATIONS AND SERVICES

INDEX

2.1 Scope of Work

(i) The contractor shall be responsible for providing plant, equipment, materials and labour for the provision of all necessary temporary works and services required for the execution of the works under this contract.

(ii) The contractor shall design, furnish, install, maintain and operate on the site all constructional plants as specified in this chapter, including camps, workshops, warehouses, storage and assembly areas, all machinery, vehicles, scaffolding, equipment, water and power supply etc.

(iii) Temporary works and services carried out by the contractor shall conform to the applicable Indian Standards, codes and sanitary requirements stipulated for such purpose.

(iv) The design, construction, operation and maintenance of the contractor's temporary works and services shall be subject to inspection and approval by the Engineer.

(v) Unless otherwise specified in the conditions of contract, all plants, camp facilities, installations and services provided by the contractor shall at all times remain his property. Should, after the completion of contract, the contractor wish to sell his plants, facilities and equipment in Nepal, he shall also pay all taxes and duties required by law as stipulated in the conditions of contract.

(vi) Unless otherwise specified in the conditions of contract, all access/approach roads and haulage roads shall be constructed and maintained by the contractor.

(vii) Temporary roads shall be constructed and maintained by the contractor at his own cost.

2.2 Submittals

(i) Within 20 days from the date of issue of the Letter of Acceptance, the contractor shall submit to the Engineer, updated layout plans showing, to an adequate scale, the locations and arrangement of all temporary works and facilities. These plans shall be consistent with the plans submitted by the contractor with his bid as well as with any amendments and additions subsequently agreed to by the Engineer and the contractor, and shall include:

(a) Camps for contractor's employees.

(b) Offices, parking areas, warehouses, storage areas and medical-care services.

(c) Water supply, sewerage, sewage treatment and disposal, power supply and illumination, telephone services

(d) Temporary road works, including public road diversions.

(e) Equipment pools and mechanical workshops.

(f) Dumping areas, borrow, quarry and stockpile areas.

(g) Concrete and material processing plants, including cement storage.

(h) Explosive magazines.

(i) Underground ventilation system.

(j) Security and safety arrangements.

(k) Field laboratory alongwith list of equipments.

(ii) Within 30 days from the date of issue of the Letter of Acceptance, the contractor shall submit to the Engineer the following:

(a) Detailed drawings, to a scale of 1:500, showing the camp layout, buildings, roads, recreation areas, all utilities, etc., and drawings to a scale of 1:50 showing typical building construction details.

(b) Drawings and specifications for the establishment of an infirmary, first aid stations and ambulances.

(c) Detailed design for industrial and potable water supply to the camps and working areas as well as sewerage systems, sewage treatment and disposal with an estimate of number of people to be supplied with water.

(d) Detailed layout drawings for electrical installations and distribution systems, on the site, showing voltages, outlets and routing of power lines.

(e) Detailed design and drawings including manufacturer's drawings for concrete and materials processing plants in accordance with the requirements of the pertinent chapters of these specifications.

(f) Details of the drilling and grouting equipment in accordance with the requirements set out in the relevant chapter of these specifications.

(g) Details of the underground ventilation system which shall include all calculations of fresh air supply volume, type of ventilation scheme, duct diameters, materials and equipment and position of ventilators and dust arrestors. Description of the working cycle including number of persons employed, number and capacity of diesel powered equipment working at one time at each heading face shall also be included.

h) Details of dewatering system

The design shall be consistent with the proposal submitted by the contractor with his bid as well as with any subsequent amendments and additions agreed to by the Engineer and the contractor. The dewatering system shall require prior approval of the Engineer.

(iii) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

(iv) Within 30 days from the date of issue of Letter of Acceptance, the contractor shall submit to the Engineer an environmental monitoring and protection plan in accordance with the latest guidelines issued by Ministry of Population and Environment(MoPE), GoN and Govt. Bodies. It should describe all measures to be taken by the contractor to comply with the requirements. This plan will cover all measures to be taken by the contractor to prevent, minimise or make good all possible environmental effects of the construction work, in particular:

a) Deterioration of the quality of water in rivers and streams, and of ground water.

b) Accumulation of and pollution by solid and liquid waste material anywhere in the project area.

c) Undesirable levels of noise, air pollution and dust both at the construction site as well as along the access road, in quarries and borrow areas.

d) Occurrence of water-borne and other communicable illnesses amongst site workers and their families, and the deterioration of levels of hygiene in the camps and construction areas.

This environmental plan will also describe the procedures to be adopted by the contractor for reporting on the environmental protection programme and for informing and communicating with government institutions. The plan will also give details of arrangements made by the contractor with local land-owners for the leasing of land for site installations, camps etc., and will include drawings detailing the areas in question. Unless specified otherwise, no additional cost in respect of environment protection measures shall be paid by Employer.

2.3 Installations and Services for the Contractor's Use

The installations and services to be provided by the contractor for the execution of the works under this contract shall include, but not be limited to, the following:

2.3.1 Contractor's Site Offices, Stores, Warehouses, Materials yards

(i) The contractor shall provide and equip, for his own and his sub-contractor's use, main and secondary offices, warehouses, materials stock areas, fuel storage areas and explosives magazines, all of which shall be maintained in good condition until the completion of Works.

(ii) The buildings, shops and warehouses expected to be constructed and equipped by the contractor for use in the performance of the works under this contract, in addition to the facilities explicitly specified elsewhere in these specifications shall be, but not limited to, the following:

(a) Mechanical repair shop

(b) Electrical repair shop

(c) Metal work fabrication and carpentry shop

(d) Main warehouse and parts store

(e) Bulk cement silo/cement store

(f) Spare parts store

(iii) The contractor shall be required to have on the Site sufficient stock of the following materials and also as specified in PCC:

(a) Gasoline

(b) Diesel and Lubricants

(c) Cement

(d) Explosives

(e) Steel reinforcement

(f) Rock bolts and Steel ribs

(g) Spare parts

(h) Aggregate and sand at batch plant or crushing plant

(i) Admixture for concrete and shotcrete.

If additional space is required for storage of material in addition to the space provided by Employer, in accordance with contractual obligation, then the same shall be arranged by him without any cost to Employer.

2.3.2 Concrete and Materials Processing Plants

i) The contractor shall install and erect all necessary material processing plants of sufficient capacity to meet the planned peak requirements during construction. The plants shall be subject to approval by the Engineer and shall be well designed and fabricated and kept in good running order to ensure compliance with the materials quality specifications. All control and measuring equipments shall be regularly serviced and calibrated.

ii) The plants required to be assembled/erected by the contractor shall be, but not limited to, the following:

(a) Concrete aggregates processing plant (crushing and screening). The aggregate processing plant should be provided with cyclone separator for dust suppression.

(b) Concrete plant (batching and mixing)

(c) Concrete cooling plant (refrigeration and ice plant)

(d) Grouting plant

iii) Concrete and material processing plant shall meet all environment guidelines/conditions imposed for construction of project by Ministry of Population and Environment(MoPE), GoN and Govt. Bodies at no extra cost to Employer.

2.3.3 Communication Systems

2.3.3.1 Site Communications

(i) The contractor shall be required to provide communication facilities to his offices, camp sites, infirmaries and first aid stations, laboratories, workshops, stores, aggregate plants, batching plants, tunnel portals, quarry sites, various other work sites and other areas within the site at his own cost.

(ii) In addition to the local telephone system, the contractor shall supply, install and maintain mobile two-way radio transceiver sets and/or mobile telephone sets for his service vehicles for on-site communications. Walkie-talkie transceivers may also be required to monitor critical working areas, like concreting, where telephone or mobile radio is not feasible. Adequate number of handsets shall be provided to his staff. Any permission of the Government, if required, shall be arranged by the contractor himself. The Engineer may assist the contractor in getting such permission, but without any contractual obligation.

2.3.3.2 Communication System in Underground Works

(i) The contractor shall install and maintain in operating condition, communication system by telephone or preferably an underground radio system approved by the Engineer between each heading face, entrance to the tunnel and adit portals at his own cost.

(ii) In the long tunnel reaches, an intermediate Intercom station shall be located at least every 500 m along the tunnel.

(iii) This communication system shall have its source of energy independent of the main energy supply for underground works.

(iv) The availability of the communication with outside shall be ensured at all times throughout the duration of the underground construction.

2.3.3.3 Outside Communications

(j) The contractor shall supply, install, operate and maintain a radio communication system (transceiver VHF/SSB) on the site, to maintain contact between the contractor's field offices and between these offices and his main office at his own cost.

(ii) The contractor shall, at his own cost, obtain necessary permission/license for radio communication system. The Engineer, if approached by the contractor, will endorse the necessary radio license application of the contractor.

(iii) Upon the completion of works, the contractor shall dismantle and remove from the site the installed radio communication system and surrender the license under information to the Engineer. However, the Employer reserves the right to purchase some or all of the equipment at depreciated value or as may be mutually agreed, whichever is lower.

2.3.4 Service Vehicles

The contractor shall furnish, operate and maintain sufficient service vehicles for use by his own staff and employees in the management, supervision and performance of the Work.

2.3.5 Camps for Contractor's Employees

(i) The contractor shall design, construct, provide furnishings, maintain and operate construction camps at the locations approved by Engineer. The construction camps shall provide for the housing, feeding and recreation of the contractor's employees and those of his sub-contractors. Kitchens, dining rooms, outdoor and indoor recreation facilities, family dwellings, dormitories, sanitary facilities, medical service, place of worship, roadways, drainage, fire control, commercial centers and all utility services (potable water, power, lighting, heating, ventilating, sewage treatment and disposal, cleaning and sanitation, garbage collection and disposal etc.), shall be provided. The camps shall be large enough to accommodate the anticipated peak work force.

(ii) Before start of work, the Contractor shall inform the Engineer about the layout drawings of the contractor's camp and colonies before start of construction. The specifications and the quality of structures for contractor's camps and colonies and all temporary works shall be sound enough so as to be safe for the living of contractor's workman and staff for the entire construction period. The contractor shall be entirely responsible for the adequacy and safety of such structures notwithstanding any prior information of the same to the Engineer for the same.

(iii) All camp buildings shall be semi-permanent structures and connected to all utility services.

(iv) Fixtures in the sanitary facilities shall be based on the following user ratios:

(a) 1 toilet for not more than 6 users

(b) 1 tap for not more than 6 users

(c) 1 wash basin for not more than 6 users

The sewage from the labour camps, work sites is to be properly treated before discharge by providing septic tanks, soak pits etc.

(v) Canteen facilities shall be provided by the contractor in properly equipped canteen buildings for all of his and his sub-contractor's employees.

(vi) The contractor shall be responsible for keeping the camps and buildings within it, in good hygienic conditions. The Standards and regulations presently in force in the project area with regard to personnel treatment, sanitary conditions, and fire and accident prevention shall be duly taken into account.

(vii) Canteen shall be run and maintained in accordance with the relevant rules and statutory provisions of Govt. of Nepal/Govt. Bodies as may be applicable.

(viii) Use of wood as fuel is prohibited. The contractor shall make alternative arrangements for fuel to run the canteen/community kitchen and also for sub-contractor or labour engaged for construction activities.

(ix) The contractor shall be responsible for the acquisition of, and the expenses for the required land.

2.3.6 Commercial Establishments

i. The contractor may collect information regarding market and shopping complexes in the area by inspecting the site and the area in the vicinity thereof and satisfy himself before bid submission on availability of such facilities. However, the contractor may establish commercial places in his camps for use of his employees. Such commercial places, if established by contractor at working site or in residential colonies, would not be allowed to operate on commercial basis for the use by public at large.

ii. Commercial establishments set up by the contractor and leased to a third party by the contractor for the use of the employees and residents on the site, shall be subject to approval by the Engineer. Any lease shall be revoked if the lessee violates the law or the provisions governing the granting of the lease. The leases shall automatically terminate upon completion of the works or in the event of the termination of the contract.

iii. No lease shall be granted for activities that are contrary to statutory regulations or are declared by the Engineer to be offensive to the community.

iv. The lessees will be regarded as sub-contractors of the contractor.

2.3.7 Medical Facilities

(i) The contractor shall collect all information regarding availability of medical facilities in the vicinity.

(ii) In addition to above, the contractor shall construct, equip and maintain on the site, the following medical facilities:

(a) One clinic with ambulance and driver at his main camp.

(b) One first aid station at each work site.

(iii) The contractor shall comply with laws and health Standards presently in force in the project area. In the event of an epidemic breaking out, the contractor shall carry out and comply with all orders, arrangements or regulations which may be issued by the Government or local authorities.

(iv) These facilities shall be fully equipped and staffed to meet the requirements of the maximum anticipated work load and labour force, taking into consideration the nature of the Works, its occupational hazards, location and accessibility. These establishments shall be available and fully operational within 90 days after the date of issue of the Letter of Acceptance.

(v) Medical services in the clinics shall be available under the direction of a qualified doctor throughout the duration of the construction.

(vi) Treatment facilities and care of seriously ill or injured patients shall be on an emergency basis until their transfer to an established hospital.

(vii) The construction of these facilities shall be such as to provide reasonable quiet, privacy, communications, adequate ventilation, heating, light, hot and cold water, toilet facilities, electrical outlets, and impervious floors, walls and roofs.

2.3.8 Power Supply and Illumination

2.3.8.1 Power Supply and Illumination Provided by the Contractor

(i) The contractor shall ensure adequate illumination for all his operations on the site and at the camps, including illumination of the streets.

(ii) The vaults along the entire length of the tunnel shall be illuminated with electrical light throughout the duration of construction works. The lamps shall be located as follow:

(a) every 25 m in unlined stretches

(b) every 50 m in lined stretches

Each lamp shall have a minimum capacity of 100 W. The lamps shall be installed in a particular area immediately after the rock supporting measures have been completed and shall be as under:

	Area of Operation	Luminous intensity

a)	Excavation and dumping areas, and outdoor access ways	50 Lux
b)	General construction areas, outdoor concrete placement, active storage areas, loading platforms, refueling, and field maintenance areas	50 Lux
c)	Indoor construction areas	100 Lux
d)	Tunnel and general underground work areas	100 Lux
e)	Tunnel headings during drilling, mucking and scaling	100 lux
f)	General construction plant and shops e.g. batching plants, mechanical and carpentry shops, active storerooms, barracks or living quarters, mess halls and indoor toilets	100 lux
g)	First aid stations, infirmaries and offices	550 Lux
h)	General interiors, warehouses, corridors, hallways and exit ways.	100 Lux
i)	Welding	330 Lux

(iii) Electrical cables shall be well insulated, protected and firmly fixed to the walls of the tunnel by means of adequate insulators. Lamps shall be well protected against damage.

(iv) The contractor shall also provide suitable movable lamps to illuminate any area in underground works where the Engineer may wish to carry out inspection, rock mechanics tests or instrumentation.

(v) No energized electrical cables shall be permitted nearer than 40 m to the heading face while charging explosives.

(vi) Lighting by flame is expressly forbidden in the underground work.

(vii) Whenever more than one agency is working in the same area, the contractor, who has already provided lighting arrangements, shall extend the facilities to the other contractor, who shall pay for such facility of utility at mutually agreed rates. In case of disputes, the matter shall be decided by the Engineer, whose decision shall be final.

(viii) To the extent possible, the contractor shall use solar lighting system or any other non-conventional energy saving methods for illumination of various facility areas and street lighting etc.

2.3.8.2 Earthing of Wetwork Areas, Control of Electric Discharges

(i) All equipment and appliances which are exposed to lightening shall be earthed electrically, and the effectiveness of such earthing shall be periodically checked by the contractor's specialized personnel.

(ii) No equipment electrically powered by more than 24 volts shall be operated by personnel standing in water.

(iii) Only air, battery-powered or hydraulic tools shall be permitted in the wet areas.

(ix) Where electrical blasting is used, equipment shall be installed to control possible electric discharges in the ground due to storms, electric motors, etc. As soon as such discharges are noted, electrical blasting operations shall be suspended, or the detonator type changed.

2.3.9 Maintenance of Traffic

i. The contractor shall be responsible for the safety along the roads related to the site. Where the work is carried out on the Site of, or close to an existing road, the contractor shall maintain the vehicular and pedestrian traffic safe at all times. If his operations can cause traffic hazards, he shall repair or fence or take such other measures for ensuring safety which are satisfactory to the Engineer.

ii. The contractor shall submit his weekly activity schedule and the locations of his work along the existing public roads to the authorities concerned, and obtain all necessary approval prior to the commencement of the respective work.

iii. At the road crossings or in heavy traffic locations, the contractor shall carry out the work within the working hours as directed by the Engineer, and after the completion of the work he shall immediately make the necessary backfill and pavement at the crossings.

iv. The contractor shall provide temporary passes and bridges to give an access to the existing village houses, etc., to the satisfaction of the Engineer and the authorities concerned whenever he disturbs such existing way during the execution of the works.

v. Roads subject to interference by the work shall be kept open or suitable detours shall be provided and maintained by the contractor, who shall provide, erect, and maintain all necessary barricades, suitable and sufficient flashlights, flagmen, danger signals, and signs.

vi. Roads, which will be closed to traffic, shall be protected by effective barricades on which acceptable warning and detour signs shall be placed. All barricades shall be kept illuminated and all lights shall be kept on from sunset to sunrise.

vii. In case strengthening of existing Deptt. Of Roads(DoR), GoN bridges and roads leading to the site is required for movement of heavy machinery/load, the same shall be carried out by the contractor at no cost to the Employer. Such

strengthening measures shall be carried out by the contractor after taking due permissions from the respective authorities, if so required.

2.3.10 Ventilation of Underground Works

2.3.10.1 General

(i) The contractor shall design, install and operate ventilation system for the underground works and provide an underground atmosphere monitoring system. Details of the proposed systems shall be submitted to the Engineer for approval within 30 days after the day of receipt of the notification of award. This updated design shall include all calculations of fresh air supply volume, type of ventilation scheme, duct diameters, materials and equipment and position of ventilators and dust arrestors. Description of the working cycle including number of persons employed, number and capacity of diesel-powered equipment working at one time at each tunnelling face shall also be included. The design shall be consistent with the proposal submitted by the contractor with his tender as well as with any subsequent amendments and additions agreed to by the Engineer and the contractor.

(ii) All parts of the Works shall be maintained in a state which will not be injurious to the health of the personnel. The air underground shall contain no less than 20% oxygen and shall not contain concentration of gases, vapours or dust greater than is safe for the health of workmen.

(iii) If required, the ventilating system shall be kept in operation also after break-through in tunnels in order to maintain the fresh air-volume requirements stated hereinafter.

(iv) Intermediate fans attached to the main duct line shall be provided as required to ensure satisfactory removal of contaminated air. All ventilation ducts shall be maintained in an airtight condition.

(v) Ventilation ducts shall be firmly fixed to the vault in such position that a minimum clearance of 20 cm remains between the duct and the extremities of train or vehicular traffic employed in the underground works.

(vi) The contractor shall ensure the required quantity of fresh air at the heading face. The check of the air tightness of joints and control of the air ducts for leaks shall be performed periodically. Any deficiency discovered or reported by the Engineer shall be immediately repaired by the contractor.

(vii) If the volume and quality of fresh air at the heading face is less than that specified, then the whole duct system shall be pressure and volume tested in portions not exceeding a few hundred meters. Measuring stations shall be located not closer than 10 times the duct diameter from any fan or other flow disturbance within the duct.

(viii) No work shall be permitted to be carried out unless the ventilation is provided to the satisfaction of the Engineer.

2.3.10.2 Ventilation System for Excavation

(i) The ventilation system in underground works shall consist of two parts:

(a) Main ventilation system

(b) Secondary ventilation system

(ii) The ventilation system shall be of such efficiency that the average air velocity in the largest excavated profile is not less than 0.3 m/s. In case the presence of methane gas is detected or suspected, this value shall be increased to 0.5 m/s.

(iii) The main ventilation system shall ensure that both the following minimum fresh air volume requirements are satisfied at all times:

(a) 4.25 m^3/min for each person employed in the Underground Works at one time.

(b) 6 m^3/min for each metric horsepower of diesel powered equipment deployed in the Underground Works at one time. This value may be reduced to 4.0 m^3/min if the equipment is using diesel oil poor in sulphur (max. 0.2% of sulphur by volume).

These fresh air volumes shall be cumulative and the contractor shall allow, in his design calculations, for the maximum number of persons and diesel powered equipment deployed in the Underground Works at any one time. Any estimated losses, e.g. due to the leaks in the ducts, shall be added to the figures stated above.

(iv) The main ventilation system shall be designed to allow the flow to be reversed and shall be operated as follows:

(a) Prior to the blasting, the system shall be put in the exhaust mode of operation. Blasting fumes shall be extracted as close as possible to the excavation face. Exhaust air and blasting fumes shall be discharged in such a way that they can neither escape to any other working place nor can they be recirculated in the fresh air supply system.

(b) Prior to the commencement of mucking and removal of material, the system will be put in the forced mode of operation, which will continue till termination of mucking.

(v) The secondary ventilation equipment of the forced type shall be installed to provide an adequate ventilation of the area between the heading face and the air intake/outlet of the main system. This system shall be switched on prior to the blasting and shall remain operative until the main system has been put into

forced mode of operation. The air intake shall be located at a sufficient distance from the heading face to ensure that blasting fumes do not permeate into this area and cause a recycling of blasting fumes. The outlet of this duct shall be located so close to the heading face that the driving of the blasting fumes and dust away from the face into main system is ensured. The minimum capacity shall be at least 70% of the main system's capacity. The end diameter of the duct shall be such that the air discharge velocity is not less than 20 m/s.

(vi) Re-entry into the heading face and resuming of the work shall not be permitted until all blasting fumes have been ejected out.

2.3.11 Air Cooling in Underground Works

(i) The contractor shall make suitable arrangements for cooling of air so as to maintain the temperature in the underground construction sites below 35 °C.

(ii) The temperature shall be jointly measured by the contractor and the Engineer at weekly intervals. Temperature measurements shall be taken during normal working conditions with the specified degree of ventilation and with the air cooling system turned off.

(iii) The maintenance of construction progress and control of temperatures shall be entirely the responsibility of the contractor. No claim for time extension and/or additional cost compensation for the completion of works shall be allowed for any reason, whatsoever on the basis of high temperature resulting from construction activities in the course of work and the cost thereof is deemed to have been included in the unit rates of relevant items of the work.

2.3.12 Control of Dust, Silica and Noxious Gases in Underground Works

The contractor shall install and operate equipment for the control of dust, silica and noxious gases in Underground Works as described herein-under. No claim for time extension and/or additional cost compensation for the completion of works shall be allowed for any reason, whatsoever on the basis of dust, silica and noxious gases encountered in the course of Work and the cost thereof is deemed to have been included in the unit rates of relevant items of the work.

2.3.12.1 Dust and Silica

(i) To reduce the amount of dust, only wet drilling will be allowed and during mucking, muck tips shall be kept constantly damp by sprinkling with water. The use of high pressure water jets for this purpose will not be permitted.

(ii) The contractor shall measure the concentration of fine dust and content of silicon dioxide (SiO_2) in all dust producing underground operations by a method to be approved by the Engineer.

(iii) Air samples shall be taken within 10 days of commencing underground excavation, at 90 day intervals thereafter and within 30 days following major changes in tunnel excavation operation, or whenever required by the Engineer. Samples shall be taken from actual working areas. The sampling and testing shall be performed by a qualified person or laboratory to be proposed by the contractor and approved by the Engineer. A copy of the test results shall be submitted to the Engineer within 2 weeks of the sampling date.

(iv) The concentration of fine dust (diameter less than 0.005 mm) may not, in general, exceed the value of 8.0 mg/m^3 of air and in relation to the silicon dioxide content in the rock this value is lowered as follows:

Content of SiO_2 in fine dust in percent by weight	**Concentration of fine dust in mg/m^3 of air**
1 – 15%	8.0 mg/m^3.
20%	6.0 mg/m^3.
30%	4.0 mg/m^3.
60%	2.0 mg/m^3.
80%	1.5 mg/m^3.
100%	1.3 mg/m^3.

(x) Should the concentration of fine dust exceed the limits stated above, the contractor shall undertake such necessary measures and install such additional equipment which will ensure that the dust concentrations are within the specified safe hygienic limits.

2.3.12.2 Noxious Gases

(i) Use of internal combustion engines, other than approved mobile diesel powered equipment will not be permitted in underground construction sites.

(ii) The contractor shall provide and maintain equipment for measuring the content of noxious gases and oxygen at each heading face throughout the duration of excavation works. Tests for determining concentrations of carbon monoxide, carbon dioxide, nitrogen dioxide, methane, other inflammable gases and oxygen shall be made before and after each blasting and at the beginning of each shift by qualified personnel. A record of readings shall be maintained and be available to the Engineer on request.

(iii) Gas concentrations in underground sites shall not exceed the following limits:

0.005% (fifty ppm) of carbon monoxide

0.5% (five thousand ppm) of carbon dioxide

0.0005% (five ppm) of nitrogen dioxide

0.001% (ten ppm) of hydrogen sulphide

0.5% (five thousand ppm) of methane

0.01 mg/l of nitrous oxide

(iv) Concentrations of other inflammable gases shall not exceed 40% of the lower explosive limit at the heading face and 20% of the lower explosive limit in the general tunnel/cavern atmosphere.

(v) If concentrations of noxious gases or other inflammable gases exceed the permissible limits set forth above, all operations shall be interrupted immediately and personnel shall be removed to a safe area. All sources of ignition shall be extinguished or removed. All equipment, with the exception of ventilation equipment, shall be shut down.

(vi) The required measures will be mutually determined and agreed by the Engineer and the contractor. In case of need, the contractor shall engage the services of an independent consultant experienced in gaseous tunnelling. Re-entry and resuming of the work shall be prohibited until the Engineer has authorized re-entry.

2.3.13 Control of Water Pollution

(i) The contractor shall construct settling tanks of appropriate size and number near crusher sites for treating effluent generated from these activities.

(ii) The contractor shall provide side drains in tunnels to channelize the construction water generated during drilling, shotcreting etc. by providing settling tanks of adequate size and number at adit portals for settling the suspended impurities.

(iii) The sludge from these various settling tanks is to be collected once in 15 days and disposed at the site designed by the Engineer.

2.3.14 Control of air and noise pollution in open excavation area

The Contractor shall install and operate equipment for the control of air and noise pollution during open excavation work as described herein under.

2.3.14.1 Control of air pollution

(i) The contractor will be responsible the maintenance and proper functioning of all construction equipment to minimize exhaust.

(ii) The contractor will operate DG sets in compliance to the Environment Rules and Regulations of GoN and Environmental Statistics published by Central Bureau of Statistics (CBS) emission norms.

(iii) When necessary, stockpiling of excavated material will be covered or staged on an offsite location by the contractor with muck being delivered as needed during the course of construction.

(iv) The contractor shall carryout sprinkling of water by using appropriate method as approved by the Engineer, on all project roads, access roads and working areas, contractor facilities, camps, etc. on a daily basis and as frequently as required, to ensure and prevent fugitive emissions. The Contractor shall be bound to carry out any other necessary mitigation measures issued by the Engineer from time to time in this regard. The use of petroleum products or similar products for such activities shall be strictly prohibited.

(v) The contractors will be required to cover stockpiled soils and vehicles hauling soil, sand, and other loose materials etc (or require vehicles to maintain at least two feet of freeboard).

(vi) To reduce the amount of dust, only wet drilling will be allowed and during mucking, muck tips shall be kept constantly damp by sprinkling with water. The use of high pressure water jets for this purpose will not be permitted.

(vii) The ambient air quality at construction sites and other facilities should be maintained within the permissible limits of the Central Bureau of Statistics (CBS), GON.

(viii) Should the concentration of pollutants exceed the limits of Central Bureau of Statistics (CBS), GoN, the Contractor shall undertake such necessary measures and install such additional equipment which will ensure that the pollutants are within the specified limits.

2.3.14.2 Control of noise pollution

(i) The contractor shall ensure that the exposure period of laborers engaged in construction work is limited as per the guidelines of Occupational Safety & Health Association (OSHA).

(ii) The contractor shall provide effective personal protective measures such as ear muffs or ear plugs to be worn during periods of exposure for all its employees.

(iii) Equipment and machineries should be maintained regularly to keep the noise generation at the design level.

(iv) Noise from the DG set should be controlled by providing an acoustic enclosure or by treating the enclosure acoustically. The Acoustic Enclosure should be made of CRCA sheets of appropriate thickness and structural/ sheet metal base. The walls of the enclosure should be insulated with fire retardant foam so as to comply with the 75 dB(A) at 1m sound levels specified by Central Bureau of Statistics (CBS), GoN from time to time. The acoustic enclosure/acoustic treatment of the room should be designed for minimum 25 dB(A) Insertion Loss or for meeting the ambient noise standards, whichever is on the higher side.

(v) The DG set should also be provided with proper exhaust muffler to attenuate noise level by atleast 25 dB(A).

(vi) The contractor shall make efforts to bring down the noise levels due to the DG set within the ambient noise requirements by proper sitting and control measures.

(vii) A proper routine and preventive maintenance procedure for the DG set shall be set and followed in consultation with the DG set manufacturer which would help prevent noise levels of the DG set from deteriorating with use.

2.3.15 Water Supply

(i) The contractor shall design, install, operate and maintain two separate water supply systems on the site:

(a) Industrial water:

For general construction use, treated to the extent necessary to meet specified requirements of works i.e. for concrete etc.

(b) Potable water :

For supply to all buildings and plants requiring high quality water meeting requirements for drinking water supply.

(ii) Water shall be supplied by the contractor from suitable natural sources which are available within the project area. The water shall be free of contamination and unaffected by the site construction work.

(iii) The contractor shall furnish, install, operate and maintain all pumps, piping, fittings, valves, storage tanks, purification plant and chlorination for the water supply and distribution systems, adequate in quantity and pressure. Industrial water shall be used for construction purposes only if it is of adequate quality. There shall be no cross connections of any kind between the industrial and potable water supply systems. Only potable water shall be piped into buildings

(iv) The contractor shall provide adequate water treatment facilities so as to ensure that the treated water is supplied for drinking purposes to all the camps and construction places.

(v) An ample number of drinking points of potable water shall be provided by the contractor for the use of personnel in all working areas.

2.3.16 Sanitation and Sewerage

(i) Chemical toilets shall be provided and maintained by the contractor for the use of all personnel at all work locations, which are remote from the fixed sanitary facilities. The contractor shall arrange for all chemical toilets to be attended to daily for proper sanitary disposal.

(ii) All offices, workshops, laboratory and other occupied work buildings shall be provided with toilets connected to properly constructed and regularly maintained septic tanks approved by the Engineer.

(iii) The camp sites shall be provided with a complete, properly maintained and operated sewerage system, including septic tanks, sewage treatment and disposal facilities. Facilities for washing clothes shall also be provided.

2.3.17 Waste and Garbage Disposal

(i) The contractor shall daily collect waste material and garbage from camps, offices and workshops and transport it to an area approved by the Engineer, where it shall be incinerated and buried or disposed off as approved by the Engineer.

(ii) The site shall be kept clean and free of refuse at all times. No waste shall be dumped in areas other than those approved by the Engineer for waste disposal. No waste of any kind shall be deposited in any watercourses.

(iii) The effluent from septic tanks shall be disposed off through absorption trenches. Drinking water facilities and waste disposal sites shall be located away from each other.

(iv) It shall be ensured by the contractor that the sewage from the labour camps do not pollute the river water or any other sources of water.

2.3.18 Management of quarry site

(i) The contractor shall carry out mining in a scientific and systematic manner.

(ii) The sites for mine waste and top soil shall be maintained by the Contractor in such a way so that there is no damage to the adjoining land and the same does not roll down the slope.

(iii) The contractor shall erect as and when required, suitable engineering structures to arrest and channelize the flow of water so that soil erosion of the land and siltation of nearby natural water bodies is prevented. For this purpose garland drains shall be constructed around quarry site to capture the runoff and divert the same to the nearest natural drain.

(iv) The pits formed after excavation are to be filled with small rocks, sand and farmyard manure and suitable plantation works are to be undertaken.

(v) The contractor is to develop the loading/unloading points in the mine area in such a way that no hindrance is caused to the traffic.

(vi) The contractor is to provide its labour with safety equipments like boots, helmets, ropes, ear plug and nose filters. Site services like rest shelter, drinking water and first aid facilities shall also be provided at the mining sites.

(vii) The contractor shall work according to Mines & Minerals 2052 & Mines Regulation 2056 of GoN including any other rule of law applicable from time to time.

(viii) The contractor shall not undertake any surface operations in any area prohibited by any authority, without obtaining prior permission in writing from the concerned authority.

(ix) The contractor shall establish a Stone Crusher to the satisfaction of the Regulatory Authorities of the Govt. of Nepal/ Govt. Bodies.

(x) After the closure of the quarry site, the contractor shall develop the area by undertaking plantation in the initial phase around the slopes and periphery of the quarry area and in between patches where excavation has not been done.

(xi) The contractor shall submit a mining plan get it approved from the Engineer.

(xii) The contractor shall undertake work strictly as per the approved mining plan

(xiii) The contractor shall be solely responsible for any damage to the adjoining land due to mining operation and also settle all disputes at its own level and shall indemnify the Govt. from all such claims.

2.3.19. Fencing and Site Security

(i) The contractor's offices, labour camps, infrastructure facilities, workshops and storage compounds, campsites and all construction areas, where exclusion of unauthorized personnel is necessary for safety and security, shall be adequately fenced, gated and guarded. A central guard house shall be established at each main entrance to the site.

(ii) The contractor shall employ an adequate force of properly trained security guards at the worksite and at the construction camps on 24 hour duty including

Saturdays and holidays. Storage areas shall be fenced, lighted and regularly patrolled by security guards. Warehouse buildings and explosive magazines shall be kept locked and keys accounted for at all times.

(iii) All employees engaged in the execution and maintenance of the works shall wear identification badges when at the worksite.

(iv) The contractor shall be entirely responsible for the losses occurring in his installations and those of the Engineer, resulting from carelessness on the contractor's part.

2.3.20 Setting up of Field Laboratory

The contractor shall establish a field laboratory for ensuring quality control measures for the works.

2.3.21 Inspection by the Engineer

The Engineer shall have the right, at any time, to inspect any part of the contractor's temporary facilities, without advance notification, and to require immediate rectification of any contravention of the specified requirements.

2.3.22 Final Clean-up

(i) Upon the completion of works, or when any plant has completed its functions, the contractor shall dismantle and demobilize all temporary facilities and remove all refuse, debris, objectionable material, and fill, grade and dress all excavated areas in a clean and proper condition acceptable to the Engineer. All such areas, as far as possible, shall conform to the natural appearance of the landscape.

(ii) No demobilization or removal of temporary facilities and equipment shall be made without the prior approval of the Engineer.

2.4 Payment for Site Installations and Services

The contractor's initial mobilization costs such as purchase and transport of constructional Plant and material to the site, planning, designing, installing, operating, maintaining and removal of all temporary works, site installations, services and facilities specified in this chapter, making submittals to the Engineer, recruiting and transferring staff, obtaining rights of way, telecommunication facilities and power supply, cleaning and grading areas for temporary facilities, and any other costs involved in preparation to carry out the Permanent Works shall not be paid separately, except those specifically provided in the BOQ, but shall be

considered included in the unit rates for the relevant items of the works. Charges, if leviable for use of water or any other charges imposed by State/local authority for any of the site installation and services to be developed by contractor; the same shall be borne by the contractor.

2.5 Surveying

2.5.1 Scope of Work

(i) The contractor shall render all services for surveys and measurements required for the performance of the Work.

(ii) These services cover in general transfer of control points to working area, the establishment of axis centerlines, alignments of project structures and features; the setting out for construction thereof, the accompanying control surveys for correct locations, dimensions and elevations as well as the necessary surveys for measurement to permit quantity calculations for invoicing.

(iii) Such surveys shall be based on and/or referred to existing basic grid of datum points, triangulation points and benchmarks extended adjacent to the Work in the project area. This grid shall be the sole basis of reference for all survey work and measurement.

(iv) The survey work shall include, but not be limited to, the following activities:

(a) All survey work, in particular field work, office work including preparation of survey maps/drawings/sketches, investigations, provision of skilled personnel, provision and maintenance of survey instruments and accessories, supply of all materials required for survey and associated purposes, provision of suitable labour, protection of all survey points, etc.

(b) Shifting machinery and temporary plant out of the required sightlines.

(c) Stopping all machinery, drilling, blasting, driving and other work causing vibrations, dust, gas etc.

(d) Restricting or stopping traffic of persons and vehicles near instruments or in sightlines during instrument observations.

(e) Providing adequate lighting or cutting of sources of light which interface with setting out or survey.

(f) Providing adequate ventilation to ensure the necessary view and to enable personnel to stay in underground work areas.

(g) Removing all obstructive accumulation of water.

(h) Taking all necessary safety precautions.

(i) Clearing sightlines by removal of bushes and scrub with the prior approval of the Engineer.

(j) Any survey required by engineer or his representative for any kind of checking of line, levels, alignment, measurements etc. whatsoever.

2.5.2 Submittals

(i) Within 30 days from the date of issue of Letter of Acceptance, the contractor shall submit to the Engineer for his approval a proposal of the sequence of the survey works to be performed, the biodata of the key personnel in-charge of survey works, the list of survey equipment and instruments the contractor will have available at the site and a brief outline on methodologies of survey works to be applied for the various types of survey.

(ii) At least seven (7) days prior to the commencement of any survey work, the contractor shall inform the Engineer of his intention to perform the survey work. The contractor shall indicate the purpose of survey, the area to be surveyed, the structure of facilities involved, the methods to be applied and the survey period.

2.5.3 Obligations of the Contractor

2.5.3.1 General

(i) The contractor shall perform all calculations, surveys and setting-out necessary to establish the accurate location of the structures as shown on the construction drawings and shall carry out all necessary surveys to verify the topographical data used by the Engineer for the project design and measuring purposes. Inaccuracy, if any observed during the above by contractor shall be intimated to Engineer. If it results into change of project design, no claim regarding inaccuracy in topographical survey/data used by engineer for the project design and measuring purpose shall be entertained.

(ii) If the contractor chooses to use triangulation points or bench marks other than those furnished by the Engineer, he shall do so at his own expense and risk.

(iii) The contractor shall carry out topographical surveys of the original ground surface in each sector of the Works where surface excavation will be necessary, and produce sufficient and adequate cross-sections which will permit later to evaluate the volume of excavation for the measurement purposes and payment of excavation.

(iv) The contractor shall entrust the surveying works only to persons who by their training and experience have sufficient qualifications and knowledge to ensure proper fulfillment of the survey tasks assigned to them. For the performance of

the survey, the contractor shall use a sufficient number of reliable and accurate instruments.

2.5.4 Materials and Instruments

(i) The contractor shall provide, maintain and operate suitable and appropriate equipment, instruments, materials and auxiliary equipment commensurate with various tasks and precision requirements of the survey works.

(ii) Type and accuracy of the survey equipment to be used by the contractor shall correspond to the nature of the construction, erection works and the construction technique.

(iii) All equipment, instruments, materials and auxiliary equipment shall be in perfect operating condition. Prior to the start of survey activities, equipments, instruments etc., shall be checked as to their proper functioning and accuracy.

(iv) During the construction period the survey instruments shall be checked and, if necessary, adjusted/calibrated at regular time intervals.

(v) Instruments and equipments which have suffered from use, damage or accidents to the extent that they are unfit for further use at the site, shall be removed from the site and replaced immediately.

(vi) The number of sets of instruments shall be sufficient to meet the requirements of the construction time schedule. Delay of start of construction or construction progress caused by insufficient quantity and quality of survey equipment including provision of professional staff shall be at the contractor's responsibility.

2.5.5 Execution

2.5.5.1 General

(i) For the execution of the survey work the contractor shall employ and provide adequate number of qualified & experienced professionals and auxiliary staff. All survey and measurement work shall be recorded and filed comprehensively.

(ii) The contractor shall provide, maintain, adjust when necessary and operate the required survey and auxiliary equipment for the performance of the work.

(iii) All survey and measurement activities shall be recorded in maps and field books as directed/approved by the Engineer. Where required, the production of drawings and maps shall be deemed to be part of the work.

(iv) The Engineer shall have the right to check work performance, accuracy, stations, etc., and all survey results, measurements and calculations as well as conformity with plans and drawings.

(v) The contractor shall keep and maintain professional records of all field surveys and measurements, the related computations and calculations, manuscripts, plans, drawings and maps, and shall make them available to the Engineer whenever requested.

(vi) If, in the opinion of the Engineer, deficiencies and/or inaccuracies in field and office work have been found, such work shall be repeated and made good to the satisfaction of the Engineer at the contractor's expense. The contractor shall be solely responsible for accuracy of survey maps and drawings prepared out of the surveys.

2.5.5.2 Augmentation of Basic Survey Grid

(i) Existing datum points and benchmark closely located to the permanent structures may be endangered by construction activities. The contactor shall therefore in due time establish additional datum points at safe locations and elevations to augment or extend the basic grid.

(ii) The new datum points shall be of permanent nature and shall be constructed as directed by the Engineer.

(iii) The contractor shall also establish reference monuments for centerlines and line control of structures, which need frequent and extended control surveys for tunnel alignment and connected works.

(iv) New datum points, reference monuments and benchmarks shall be protected and maintained in the same way as the original grid points.

(v) The contractor shall protect, preserve and keep accessible the bench marks and triangulation stations of the basic survey and those provided by himself. Any damage or removal of benchmarks and stations, including such of other parties shall be prevented. Any accidental damage shall immediately be brought to the attention of the Engineer. It is expressly stated that the contractor will be made responsible for the damage and its consequences.

(vi) Benchmarks shall be of stainless steel/concrete/cast iron. In softer soil, the steel bolt shall be embedded in a block of concrete of suitable size, and absolutely stable. Inscriptions shall be durable and clearly legible. Underground benchmarks shall be installed at suitable locations and adequately protected.

2.5.5.3 Survey of Ground Profiles

Original Ground Profiles

(i) The contractor shall inform the Engineer in writing, at least 14 days before commencing such work, of his intentions to perform any work, which will result in a change to the topography of the existing site for the permanent works and/ or for temporary works. Thereupon, before commencing any work, the contractor

shall survey the original topography with the approval of the Engineer over the entire area to be occupied or disturbed. Such survey may again be required after removal, of vegetation, topsoil or other overburden. The information so obtained shall be recorded by the contractor and the Engineer with a reproducible copy of each drawings to serve as a permanent record for the purpose of determining the quantities of excavation of earthworks carried out in the construction of the permanent structures, and the extent to which temporary works shall be removed or temporary excavations shall be refilled upon completion of the works.

(ii) The contractor shall survey all excavated and final surfaces for the purpose of recording as constructed details, and for the measurement of quantities.

- On completion of excavation and prior to placing concrete or other work.
- On completion of works.

2.5.5.4 Tunnel Alignment and Gradients

(i) The contractor shall establish and maintain at suitable distances from tunnel portal at least two (2) reference monuments and benchmarks on the extended tunnel axis/alignment, to warrant that control surveys during tunnel construction can always be referred to such reference monuments. They shall be secured by auxiliary fixed points permitting the location control of the reference monuments in case these have suffered during tunnel excavation periods.

(ii) Establishment and control surveys of the tunnel alignment and gradient shall always be referred to such reference monuments.

(iii) Underground alignment and level survey and control thereof shall be performed by the use of suitable precision instruments preferably of the pulsed laser type of equivalent instruments, and auxiliary equipment. Underground survey equipment and methodology shall be subject to the approval of the Engineer.

(iv) In addition to the regular survey, carried out by the contractor, if required by the Engineer or an independent survey organization nominated by Engineer, will perform confirmatory survey of tunnel alignments. The first confirmatory survey is likely to be performed after the 1st 100 m of tunnel has been excavated, following confirmatory survey will be carried out after every 200 m of excavation or as decided by the Engineer. The contractor shall be notified in advance about the date of such confirmatory surveys. The contractor shall cooperate with such surveyor and provide any assistance as required (including stoppage of work, if required) at no extra cost to Employer.

(v) Starting from the duly surveyed fix points at the portals, a traverse net (combination of traverse and gyroscopic measurements) and a leveling will be carried out in each case.

(vi) The Engineer and the contractor will mutually arrange to carry out such confirmation survey at a time and in such a manner, so as to limit as far as possible any delay or inconvenience to underground work. But notwithstanding the above, the Engineer may arrange such superior control to be performed at any time and notify the contractor accordingly.

(vii) Such work will have to be temporarily halted which will, in the opinion of the Engineer, cause excessive vibration or noise such as drilling, mucking, hauling persons, materials or rock spoil in or out of the tunnel, installing permanent or temporary support or any similar work.

(viii) The Engineer will normally give the contractor written notice of such stoppage at least 48 hr in advance and will state the approximate time at which work must cease and the approximate duration of such stoppage. The Engineer will also indicate what work, if any, may continue. The contractor must promptly acknowledge receipt of any such written notice and confirm this acknowledgement in writing. The contractor shall be eligible for time extension if such stoppage exceeds continuous 72 hours but shall not be entitled to any cost compensation.

2.5.5.5 Accuracy of Surveying

(i) Horizontal distances shall normally be measured with optic or electronic distance measuring instruments. Chaining with metallic tape shall be restricted to measuring of short distances and will be rejected for use in survey of traverse nets.

(ii) Elevations shall be determined by differential horizontal leveling.

(iii) Angles shall be measured by Total Station.

(iv) Traverse nets shall be executed with the precision and as per Survey of India practice and as per IS codes.

(v) Leveling shall be checked by closing the loop to the initial benchmark.

2.5.5.6 Auxiliary Works

(i) The contractor shall perform auxiliary works with regard to surveying which include, but not limited to, the following:

(a) Perform all necessary calculations with clear presentation of calculations and results in order to facilitate verification,

(b) Expose covered bench marks,

(c) Provide bench marks in lieu of and/or in addition to those in existence,

(d) Remove machinery and obstructions from the required sight-lines,

(e) Provide adequate ventilation in tunnels to ensure the necessary clear view,

(f) Provide adequate lighting or shut off sources of interfering light to ensure the necessary clear view,

(g) Provide adequate labour, and materials as deemed necessary and suitable by the Engineer for the control and auxiliary surveys,

(h) Remove all obstructive accumulation of water,

(i) Carry out additional topographical surveys in cases where the existing topographical data is, in the opinion of the Engineer, insufficient for accurate measurement of the Works,

(j) Carry out all necessary topographical surveys for the incorporation of measuring equipment and instrumentation located in the permanent Works,

(k) Carry out all necessary topographical surveys for the observation of the behaviour of structures during construction.

(ii) All the above shall be done in close co-ordination with the Engineer.

2.5.5.7 Damage to Crops and Vegetation

(i) No trees or crops of economic value existing at the site shall be damaged or removed by the contractor during survey and cross-sectioning works prior to their enumeration and evaluation.

(ii) Throughout the surveying and setting-out the contractor shall work closely with the authorised local appraisers of crops and vegetation in question and shall provide them with facilities necessary for the expeditious performance of their duties.

(iii) As soon as a section of work has been defined and valued, the contractor shall delineate the boundaries of the areas to be cleared by approved markings.

2.5.5.8 Measurement and Payments

No item of survey work shall be measured for the purpose of payment. No separate payment shall be made for survey work and related auxiliary services as the cost thereof is deemed to have been included in the unit rates of relevant items of the work.

The survey work shall include, but not be limited to, the following activities:

i. All survey work, in particular field work, office work including preparation of survey maps/drawings/sketches, investigations, provision of skilled personnel, provision and maintenance of survey instruments and accessories, supply of all materials required for survey and associated purposes, provision of suitable labour, protection of all survey points, etc.

ii. Shifting machinery and temporary plant out of the required sightlines.

iii. Stopping all machinery, drilling, blasting, driving and other work causing vibrations, dust, gas etc.

iv. Restricting or stopping traffic of persons and vehicles near instruments or in sightlines during instrument observations.

v. Providing adequate lighting or cutting of sources of light which interface with setting out or survey.

vi. Providing adequate ventilation to ensure the necessary view and to enable personnel to stay in underground work areas.

vii. Removing all obstructive accumulation of water.

viii. Taking all necessary safety precautions.

ix. Clearing sightlines by removal of bushes and scrub with the prior approval of the Engineer.

x. Any survey required by engineer or his representative for any kind of checking of line, levels, alignment, measurements etc. whatsoever.

CHAPTER – 3

MATERIALS FOR CONSTRUCTION

INDEX

3.1 Scope of Work

(i) The specifications described herein-under relate to the work which includes all labour, materials, equipment and services required to arrange materials for construction of various works under this contract.

(ii) Samples for testing of materials shall be supplied by the contractor to the Engineer at the Trial Mix Stage as set out in Chapter-Cement Concrete.

(iii) The specifications of some of the major construction materials are given hereinafter.

3.2 Submittals

(i) The contractor shall, specify in his bid and subsequently also, if required by the Engineer, the source(s) from which the cement, steel and explosives etc. will be obtained. In case the specified source(s) is not acceptable to the Employer, the contractor shall be required to substitute the source by an acceptable source approved by the Engineer without any cost liability to Employer. Additional suppliers and change of suppliers shall be subject to the approval of the Engineer.

(ii) At least 30 days prior to procuring, or dispatch to site of the materials, the contractor shall submit, to the Engineer, the following:

(a) Certified quality test reports from manufacturers in respect of cement, steel, explosives and other materials. This will also be necessary whenever the source is changed or when the sub-standard materials are received on the Site.

(b) If the materials are to be arranged from several sources, the estimated quantity to be procured from each source and the proposed schedule of supply.

(iii) The layout of the stockpiles and the method of drawing aggregates from them shall be submitted to the Engineer atleast 30 days prior to the commencement of stockpiling of aggregates.

(iv) The details relating to the source, method of delivery and storage of water to be used during construction shall be submitted by the contractor to the Engineer for approval atleast 60 days prior to the commencement of the works.

(v) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

3.3 Standards

(i) The specifications, production, sampling, testing and storage of construction materials shall conform to the following Indian Standards (latest revision) or, where not covered by these Standards, to the equivalent International Standards:

(a) Aggregates and Water

IS: 456 Code of practice for plain & reinforced concrete.

IS: 383 Specification for coarse and fine aggregates from natural sources for concrete

IS: 2386 (Part-IV) Method of test for aggregate of concrete

IS: 516 Method of test for strength of concrete

IS 9103 Specification for Concrete Admixtures

IS 2502 Code of Practice for Bending and Fixing of Bars for Concrete reinforcement.

IS 3025 Method of sampling and test (Physical and Chemical) for water and waste water.

(b) Cement

IS: 269 Specification for 33- Grade Ordinary Portland cement

IS: 455 Specification for Portland Slag cement

IS: 12269 Specification for 53- Grade Ordinary Portland cement

IS: 12330 Specification for Sulphate resistant Portland cement

IS: 1489 Specification for Portland Pozzolana cement

IS: 8112 Specification for 43-grade ordinary Portland cement

(c) Steel for Reinforcement

IS: 432 (Part-I) Specification for mild steel & medium tensile steel bars and hard drawn steel wire for concrete reinforcement.

IS: 1786 Specification for High strength deformed steel bars and wire for concrete reinforcement

(d) Structural Steel

IS: 2062 Hot Rolled Medium and High Tensile Structural Steel — Specification

IS: 808 Dimensions for rolled steel beam, channel and angle section.

IS: 8500 Structural steel – Microalloyed (medium and high strength qualities)

IS: 800 General Construction in Steel- Code of Practice

(e) Steel for Pipes

IS: 6286 Seamless and welded steel pipes for sub-zero temperature service

IS: 3589 Steel pipes for water sewage

IS: 1536 Centrifugally cast (spun) iron pressure pipes for water, gas & sewage

IS: 6631 Specification for steel pipes for hydraulic purposes

(f) Welding Electrodes

IS: 814 Covered electrodes for manual metal arc welding of carbon and carbon manganese steel - specification.

IS: 816 Code of Practice for use of metal arc welding for general construction in mild steel.

(ii) In case of conflict between the above Standards and the Specifications given herein, the Specifications shall take precedence.

3.4 Stones

(i) All stones used on the works shall be of sound, hard, durable and tough quality approved by the Engineer.

(ii) The stones shall be fine or medium grained, hard, bright in colour, breaking with a clean fracture and shall make a ringing sound when struck with a hammer.

(iii) It shall be free from decay, vesicles, holes, flaws, cracks and other defects and must have, as far as possible, uniform colour and texture. Porous stone absorbing water more than 1 % of its dry weight after 24 hr immersion shall be rejected. No stones shattered or cracked by blasting operations or having any skin or earthy cover shall be used.

(iv) Contractor may use stones obtained after excavation from underground and other works free of cost, if found suitable, subject to the approval of the Engineer. However, the royality shall be levied and paid as per the prevailing mining rules of the Government and the General Conditions of Contract.

(v) In case the stone is not considered to be free from dust, or dirt etc. by the Engineer, the contractor shall get the stone screened washed and/or treated as directed by the Engineer.

(vi) Samples of stone that the contractor intends to use, shall be submitted for approval of the Engineer not later than 45 days prior to the date of use.

3.5 Aggregates

3.5.1 General

(i) Use of aggregates (coarse and fine) containing excessive amount of zeolites, secondary minerals and such other components, which cause alkali reactivity of the aggregates and consequent reduction in durability of the concrete is prohibited. The Engineer may however, allow the use of such material either in part or in full keeping in view the extent of reactivity, the location, the nature of exposure and the structure. If the Engineer considers necessary, he may carry out mineralogical tests to ascertain the harmful minerals in the stones.

(ii) The contractor shall make his own arrangements of aggregate crushing plants etc. for crushing of aggregates from stones extracted from approved quarries or obtained after excavation from underground or other works. The contractor shall also provide cyclone precipitator and silt settling tank at each crusher site to control the dust generated during crushing the stone aggregates. In addition, the aggregate crushing plants shall meet all environment guidelines/conditions imposed by Ministry of Population and Environment(MoPE), GoN/Govt. bodies for construction of project at no extra cost to Employer.

(iii) The quality of all aggregates used in the works, as also processing such as washing, classifying, screening, rescreening, crushing and blending necessary

to meet the required Specifications, shall be subject to the approval of the Engineer.

(iv) The aggregates (for wearing and non wearing surfaces) shall be supplied only from the sources/quarries approved by the Engineer. The contractor shall supply necessary quantities of aggregates at no cost to the employer, to carry out the desired tests by the Engineer.

(v) The aggregates shall be sampled and tested by the Engineer in accordance with the standards referred under Para-3.3 above.

(vi) The tests shall be made on samples that are representative of the grading that will be used in concrete and the aggregates shall be processed by the equipment proposed for the works.

(vii) The contractor shall at all times, have access to and association with sampling and testing of aggregates and shall be entitled to discuss with the Engineer, the results and proposals for grading of aggregates.

3.5.2 Coarse Aggregates

(i) The term coarse aggregates applies to pieces of natural or crushed rock ranging in sizes from 4.75 mm to 150 mm.

(ii) The aggregates shall be composed of clean, hard, strong, durable pieces of stone, angular or rounded in shape obtained naturally or by crushing from suitable stones approved by the Engineer. As far as possible, coarse aggregates shall be of regular shape and free of flat or elongated particles. An elongated particle is defined as a particle having a maximum length of more than 5 times its maximum width. A flat particle is defined as a particle in which its maximum width or length is more than 5 times its maximum thickness.

(iii) Coarse aggregates delivered to the batching plant shall have uniform and stable moisture content.

(iv) The coarse aggregates shall be free from objectionable materials such as wood or other deleterious substances, the percentage of which in any size of coarse aggregates shall conform to the relevant Standards except that the coarse aggregates shall contain not more than 0.30 % by weight of deleterious (reactive) iron sulphides. The sum of the percentage of all deleterious substances in any size shall not exceed 3 % by weight. Coarse aggregates having a specific gravity (saturated surface-dry basis) less than 2.60 shall be rejected.

(v) The aggregates shall be resistant to deleterious, chemical or physical change such as cracking, swelling, softening, leaching or chemical alterations after its incorporation in concrete.

(vi) For concrete exposed to the flowing water at high velocities, the coarse aggregates having high abrasion resistance shall be used.

(vii) When subject to sodium sulphate soundness test, coarse aggregates shall not suffer more than 12 % loss of weight after five cycles.

(viii) The aggregates shall be crushed in approved type of stone crushers and different sizes of the coarse aggregate shall be separated into nominal sizes by screening over vibrating screens as under:

Designation of size	Nominal size range
20 mm aggregate	4.75 mm to 20 mm
40 mm aggregate	20 mm to 40 mm
80 mm aggregate	40 mm to 80 mm
150 mm aggregate	80 mm to 150 mm

(ix) The grain size distribution of the coarse aggregate for the various maximum sizes of aggregates shall be as set out in the relevant Standards.

(x) These may be altered by the Engineer from time to time, if necessary, on the basis of actual tests carried out regularly in the laboratory so as to get the best possible coarse aggregate grading.

(xi) The percentage of weight of all the significant under-sizes shall be less than 5 % when tested on the designated test screens having opening 5/6 times the normal minimum size of the material. No over size (i.e. material that would be retained on the designated test screens having opening 7/6 times the normal sizes of the material) shall be permitted.

3.5.3 Fine Aggregates (Sand)

(i) General

(a) Sand or fine aggregates shall be used for mortar in stone and brick masonry and as fine aggregates in concrete. It shall be either natural river sand or manufactured, sand crushed from rock/stones or mixture of both in specified proportions. The sand shall be composed of hard, clean and gritty pieces of stone and of a quality approved by the Engineer. It shall be

free from injurious amount of clay, soft and flaky particles, vegetable or organic matter, loam, mica and other deleterious substances and shall not contain any salts.

(b) The fine aggregates shall conform to the requirements of IS:383 (latest revision). Varying amount of moisture in fine aggregated contributes to lack of uniformity in concrete consistency. The fine aggregates shall therefore have uniform and stable moisture contents. Dry sand shall be preferred. Hence sand stockpiles shall be protected from rainfall by providing covered sheds.

(c) The percentage of deleterious substances in the fine aggregates shall conform to relevant Standards except that the fine aggregates shall contain not more than 0.10 % by weight of deleterious (reactive) ferrous sulphides. The total percentage of deleterious substances must not exceed 5 % (for uncrushed sand) and 2% for (crushed sand) of the weight.

(d) Fine aggregates having a specific gravity of less than 2.60 are liable to be rejected. Fine aggregates when subjected to a soundness test with a solution of sodium sulphate, after 5 cycles of tests, shall not suffer a loss of weight in excess of 10 %.

(e) The sand shall be well graded and, when tested by standard sieves, shall conform to the prescribed limits of gradation. The best gradation shall be determined by the Engineer, after experiments and tests and the contractor shall follow the same.

(f) The sand, as delivered to the batching plant shall have a fineness modulus of 2.6 to 3.

(g) The grading of fine aggregates shall be so controlled that the fineness moduli of atleast 9 out of 10 samples of fine aggregates delivered to the batching plant shall not vary more than 0.20 from the average of 10 samples tested. All classifying, batching or other operations on the fine aggregates shall be done by the contractor and the cost thereof shall be taken as included in the Unit Rates for the concrete or masonry item as the case may be.

(ii) Natural Sand

(a) Natural sand shall be obtained from an approved source. No sand affected by salty water shall be used. The sand shall be screened and thoroughly washed, preferably in flowing water so as to remove all earthy impurities and very small fines unless otherwise permitted by the Engineer.

(b) Natural sand shall be free from laterite and other softer grains and all sources of sand showing appreciable percentage of these impurities shall be rejected.

(c) The presence of mica in the fine aggregate has been found to reduce considerably the compressive strength of concrete. It is advisable, therefore, to investigate the mica content of the fine aggregates and make suitable allowances for possible reduction in strength of concrete or mortar. The decision of the Engineer whether to use such sand and if so, what allowances to be made, shall be final and binding on the contractor.

(d) The contents of the organic matter shall conform to relevant standards.

(iii) Manufactured Sand

(a) Whenever natural sand conforming to the required specifications is not available, recourse shall be taken to manufacture sand of desired quality by crushing of stones. The contractor shall comply with the directions of the Engineer in this behalf. The stone that will be used in crushing for getting fine aggregates shall conform in all respects to the stone/coarse aggregates specified under Para-3.4, 3.5.1 and 3.5.2 hereof.

(b) In case the natural sand or the manufactured/crushed sand is not considered to be as per Specifications, the same may be rejected outright by the Engineer or the sand may be allowed after processing, provided the sand conforms to the requirements after such treatment.

(c) For improving workability of pumpable concrete mixes, the contractor may consider a combination of natural and manufactured sands. Proposed proportions shall be submitted for approval of the Engineer.

3.5.4 Storage of Aggregates

(i) Unless specified otherwise, the contractor shall, at all times, maintain a storage of all grades of aggregates for atleast one month's requirement.

(ii) Adequate drainage of stockpiles shall be provided.

(iii) The stockpiling of the processed aggregate and drawl therefrom shall be such as to ensure that the variation in the free moisture in the aggregate, during any one shift of working, does not exceed 1 % .

(iv) The coarse aggregates shall, as far as possible, be stored in a shade or covered storage and arrangement made for sprinkling of water to ensure wetting of the aggregate.

(v) Care shall be taken in screening and stocking of the coarse aggregates so as to avoid intermixture of different gauge materials and inclusion of any foreign materials.

(vi) The stockpile shall be built up in horizontal or gently sloping layers.

(vii) Trucks and bulldozers shall be kept off the piles to prevent breakage and impairing the cleanliness of aggregate.

(viii) A hard base shall be provided to prevent contamination from underlying materials in storage areas in continuous use.

(ix) Overlap of different sizes of materials shall be prevented with suitable walls or by ample distance between storage piles.

(x) If the height of fall of aggregate from conveyor belt to the stockpiles is large, it is likely to get segregated and in such cases, it is preferable to have rock ladders and where possible, to limit the height of fall to the minimum.

(xi) Arrangements shall be made to store natural and manufactured sand in a way that shall protect it from being contaminated with dust, organic matter or other deleterious substances.

3.6 Water

(i) Though water may be available from natural sources within the project area, the contractor will search/explore for suitable water source(s) if water from natural sources is either not suitable or is inadequate. The reliable water supply for construction purposes shall be installed and maintained by the contractor.(#)

(ii) Adequate water storage facilities shall be provided by the contractor at the batching and mixing plant and other Work Sites so that various operations of Works do not suffer due to temporary breakdown in the main supply system.

(iii) The contractor shall establish the suitability of water after necessary testing and submit the results to the engineer for approval of source.

(iv) If required, the contractor shall supply the water sample from intended source to the engineer for testing and assess the suitability of water to be used for construction purpose.

(v) Water for washing of aggregates, mixing mortar, concrete or grout shall be clean and free from earth, vegetable or organic matter, injurious amount of oils, acids, sugar, salt and alkaline substances in solution or in suspension and

shall conform to relevant Standards. The maximum allowable contents of Sulphates (SO4) shall be 400mg/l and those of Chlorides (Cl) shall be 2000 mg/l for plain concrete Works and 500 mg/l for reinforced concrete Works. Turbidity shall be within 2000 mg/l (or 0.2 % by weight) and preferably as low as possible.

(vi) Water used for curing shall be clean and free from contamination and from excess amounts of acids or alkalis or other matter combining chemically with and thus, disfiguring the concrete surface. Water shall not contain purified organic matter causing stink.

(vii) Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90 % of the average of strength of three similar concrete cubes prepared with distilled water. The cubes shall be prepared, cured and tested in accordance with the requirements set out in Chapter-Cement Concrete.

3.7 Cement

3.7.1 General

(i) The contractor shall procure the cement of the specified quality from the cement sources/plants approved by the Engineer. For this purpose, the Engineer will approve atleast two sources/plants out of those intimated by the contractor so that one is a standby for taking care of any eventualities.

(ii) Cement to be used for various Works shall be of different types such as Ordinary Portland Cement (OPC) or Portland Pozzolana Cement (PPC) or Portland Slag Cement (PSC) or Sulphate Resistant Cement (SRC) as approved by the Engineer and shall conform to the relevant standards at the time of its use.

(iii) Hot water conditions/hot ambient conditions may be encountered during underground excavation. In case, after testing of water samples, it is found that both hot water and cold water in the adjoining reach contains chemicals aggressive to concrete lining then OPC/PPC/PSC shall be used as specified in the relevant code and as per mix design approved by the Engineer.

(iv) The Engineer shall have the right to check or test the cement at any stage of its manufacture or delivery and the Employer's test reports shall supersede the test report given in the manufacturer's certificate.

(v) Aggregate, which has alkaline reactive tendency, shall be avoided for use in concrete. In case such aggregate has to be used, prior approval of the Engineer shall be obtained. For establishing suitability of construction material

for incorporation in Permanent Works, contractor shall at his own cost carry out all the tests and submit the reports for approval of Engineer before use of such material. The agencies for carrying out the tests shall also be approved by Engineer. Further, during the time utilized in carrying out alkali aggregate reactivity test, in order to avoid delay in execution of works, the contractor shall at his own cost make use of the cement with alkali contents (i.e. K_2O and Na_2O expressed in equivalent weight of Na_2O) not exceeding 0.6 % by weight of OPC clinker which is used in the manufacturing of type of cement.

(vi) The cement will be sampled and tested by the Engineer for strength and physical properties and chemical analysis will be carried out as set out in the relevant Standards.

(vii) The Cement samples for testing at the source/plant shall be obtained by the contractor as the bins are being filled. Tests for false set shall be made on samples taken at the latest time prior to shipment.

3.7.2 Transportation

(i) Cement shall be delivered on site in bulk containers approved by the Engineer. Delivery of cement in bags will be allowed only in exceptional circumstances, with the specific approval of Engineer.

(ii) All bulk containers/carriers shall be clean and dry prior to filling/loading with cement and equipped with weather proof closures on all openings.

(iii) Transportation of cement shall be undertaken in such a manner that no damage is done to the quality of cement

3.7.3 Storage

(i) Sufficient storage facilities shall be provided at the batching plant to enable each new shipment of cement to be stored separately from the cement stored from earlier shipments.

(ii) Cement shall be stored above ground, adequately protected against rain, sun and moisture. Bulk storage bins and silos shall be emptied completely and cleaned of all cement accumulation after every 3 months.

(iii) Arrangements shall be made such that stocks of approved cement are adequate to meet the programme of Work at all times. The programme shall allow time for testing and approval of each shipment before such cement is incorporated in the Works.

(iv) Cement shall be used in the order in which it is to be received on site. Cement of different brands, if received on site, shall not be combined in the same mix and structure. Such cement shall be used in different structures as approved by the Engineer.

(iv) Handling and storage facilities shall be such that no cement is stored before use for more than 120 days. Should any cement be unavoidably kept in storage longer than 120 days, it shall be tested and if found defective, shall not be used in the Project works and shall be promptly removed from site at contractor's cost.

3.8 Admixtures

(i) Admixtures shall be proposed by the contractor and shall be used only upon written approval of the Engineer.

(ii) Admixtures shall be stored and handled so as to avoid contamination or damage to their properties by temperature or moisture changes or other influences.

(iii) The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's printed instructions, or as required to produce specified results and approved by the Engineer.

(v) The contractor shall be held liable for any damages and difficulties resulting from the selection and use of admixtures such as delay in concrete placing or damage to concrete during forms removal, and shall not be entitled to any time extension or claims resulting herefrom.

3.9 Steel for Reinforcement

3.9.1 General

(i) The contractor shall procure the steel for reinforcement of the specified quality from the sources/plants approved by the Engineer.

(ii) Steel for reinforcement shall conform to relevant Indian Standards or equivalent.

(iii) Steel shall be free from loose mill scale, rust, oil, grease, dirt, paint or other deleterious matter, when examined immediately before concrete is being placed.

(iv) Wire for tying reinforcement steel shall be black annealed iron wire or acceptable equivalent, with a diameter not less than 1.6 mm and shall have an ultimate strength of 5.68 t/cm^2 and yield strength of not less than 8.8 t/cm^2 .

3.9.2 Transportation and Storage

(i) Transportation shall be undertaken in such a manner that no damage is done to the steel.

(ii) Reinforcement steel shall be stored off the ground in separate groups according to size and length. Reinforcement steel, which has been cut and bent according to the schedules provided by the Engineer, shall be marked with bar number, as shown in the schedule, by using some form of weather proof tag or by placing in marked bins, and shall be stored in such a manner as to be readily accessible when required and to facilitate inspection.

3.10 Structural Steel

3.10.1 General

(i) The contractor shall procure structural steel of the specified quality from the sources/plants approved by Engineer. If the contractor procure the steel from these specified sources, approval of Engineer is still required.

(ii) All structural steel shall be of new/unused stock, clean and straight, free from excessive rust or scale and without any sharp kinks, bends or other objectionable defects.

(iii) Structural steel including steel plates and steel to be used for supports for tunnel and cavities as also for bolts, nuts and washers etc. for steel supports shall conform to relevant standards.

(v) The material used in splices shall conform to the specifications of the material being spliced.

3.10.2 Transportation and Storage

Structural steel shall be transported, handled and stored in such a manner that no damage is done to the materials or the structure.

3.11 Sampling, Testing & Quality Assurance

Sampling testing and Quality Assurance shall be carried out as per relevant codes.

3.12 Measurement and Payments

Unless specified otherwise, no separate measurement and payment shall be made for supply, transportation, storage and testing of materials.

CHAPTER – 4

EXPLOSIVES AND BLASTING

INDEX

4.1 Scope of Work

(i) The specifications described herein under relate to supply, transportation, handling, storage and use of explosives. All operations shall be carried out by the contractor as per Indian Explosives Act/ Explosives Act of Nepal and any other Act, Regulation or Rules concerning storing, handling, safety and use of explosives.

(ii) The contractor shall, in due time, apply for a permit/license which allows him to buy, store and use the explosives required for the works. He shall acquaint himself with all applicable latest laws and regulations concerning storing, handling, safety and use of explosives. The Engineer may issue modifications, if required and the contractor shall comply with the same without these being made a cause for claim, whatsoever, against the Employer.

(iii) Contractor shall be responsible for non-compliance of provisions of Indian Explosives Act/ Explosives Act of Nepal or any other Govt. Rule/Regulation regarding transportation, use and storage of explosives by contractor or his representative. Employer or Engineer shall not be responsible for such act of contractor or his representative, whatsoever.

4.2 Submittals

(i) At least 60 days prior to the commencement of the excavation Works, the contractor shall submit to the Engineer for approval, the details relating to transportation, storage and use of materials such as explosives, detonators, fuse coils, tamping materials etc.

(ii) The Engineer reserves the right to ask any additional information deemed necessary to be included in the submitted documents.

4.3 Standards

(i) Transportation, handling, storage and use of explosives shall conform to the following Indian Standards (latest revision) or, where not covered by these Standards, to equivalent International Standards:

Act: Indian Explosives Act
Act: Explosives Act, Nepal

IS: 4081 Safety code for blasting and related drilling operation underground excavation in rock.

IS: 6609 Methods of test for commercial blasting explosives and accessories.

IS: 10081 Terms relating to Commercial Explosives, Pyrotechnics and Blasting Practices.

IS: 7526 Detonating fumes-Specification.

IS: 7632 Specification for Detonators.

IS: 5878(Part-II) Code of Practice for Construction of Tunnels –
Part II: Underground Excavation in Rock –

Section 1 Drilling and Blasting

Section 2 Ventilation, Lighting, Mucking and Dewatering

IS: 15447 Commercial blasting explosive Specification-Nitro glycerin based (Part-1)

IS: 14881 Method of blast vibration monitoring-Guidelines.

(ii) In case of conflict between the above standards and the specifications given herein, the specifications shall take precedence.

4.4 Supervision

Before taking up blasting operation, contractor shall carry out studies or get the studies done (through reputed institutions having expertise in the area such as NIRM, CSMRS, CIMFR or any other institute of repute as approved by Engineer, based on actual field trials), covering blasting pattern, minimum safe charge, vibration control/monitoring etc. for various classes of rock mass likely to be encountered during HRT and other excavation and submit report to the Engineer.Such study/report shall have to be got updated/improved periodically during the excavation period.

Excavation by blasting shall be permitted only under the supervision of competent, trained & certified blastman who are fully experienced in the Work and who have received adequate instructions. The contractor shall make sure that his blasting crew is fully conversant with the rules and regulations concerning storing, handling and use of explosives.

4.5 Transportation and Handling

(i) Explosives shall not be transported to the site of operations except in suitable cases or containers which are so made as to prevent any spillage of explosives and any danger of sparks or other sources of ignition during conveyance. No explosive shall be removed from such cases or containers except when it is to be used forthwith for the purpose of the Work.

(ii) Suitable explosive vans, duly approved by the Engineer, shall be used for transportation of explosives and detonators. The following rules shall be observed for use of Explosive Van:

(a) Vehicles shall have springs under the body. Tyre pressures shall be as per relevant explosives regulations.

(b) Detonators and ignitors shall not be carried in the same vehicle with explosives.

(c) Besides the driver, only one helper shall be accommodated in the explosive van. The vehicle carrying the explosives shall not be used to transport workmen or other materials to workspots although there may be enough space for men or materials.

(d) Drivers shall not leave the vehicle unattended while transporting explosives.

(e) All vehicles transporting explosives shall be marked or placarded on both sides and ends with the word 'EXPLOSIVES' in bold letters. All explosive boxes shall bear explosive's Lot No., Mfg. Date, Expiry date etc. clearly on them.

(f) A motor vehicle carrying explosives shall not be refueled except in emergencies and that too only when motor is stopped and other precautions taken to prevent accidents. Such vehicles shall invariably have at least two fire extinguishers placed at convenient points.

(g) Vehicles transporting explosives shall never be taken into a garage, repair shop, parked in congested areas, or in a public garage or similar building.

(h) Explosives shall not be transported on a public highway during hours of darkness except in extreme emergency and that too only with the written approval of the Engineer.

(i) Explosives shall not be transported in any form of trailer, not shall any trailer be attached to a motor truck or vehicle hauling explosives.

(j) No transfer of explosives from one vehicle to another shall be made on any highway except in case of emergency.

(k) Persons employed in the transport or handling of explosives shall not carry with them or in the vehicles, matches, loaded fire arms, petrol or any flame-producing devices.

(l) All explosives shall be adequately protected against theft.

(m) Smoking shall be prohibited during handling and transport of explosives.

(n) The speed of the vehicle shall not exceed 25 km. per hour on rough roads and 40 km. per hour elsewhere.

(o) The interior of the body of the vehicle shall not have any exposed metal parts except those of copper, brass and other non-sparking metals and shall be preferably lined with wood.

(iii) Motor vehicles used for transporting explosives shall be carefully inspected daily to ensure that:

(a) Filled and serviceable fire extinguishers are in position;

(b) The electric wiring is well insulated and firmly secured;

(c) Chassis, engine and body are clean and free from surplus oil and grease;

(d) Fuel tank and feed lines are not leaking;

(e) Lights, brakes and steering mechanism are in good working order; and

(f) Vehicle is in proper condition in all respects for the safe transportation of explosives.

(iv) Boxes of explosives shall not be handled roughly or allowed to fall.

(v) Containers of explosives shall be opened only by means of non-sparking tools or instruments.

(vi) After the loading of a blast is completed, all excess explosives and detonators shall be removed to a safe location or returned at once to the storage magazine, observing the same rules as when being conveyed to the blasting areas.

(vii) Containers for detonators shall always be used only for storing detonators.

(viii) Explosives and detonators shall be carried in separate containers.

(ix) The driver of the vehicle carrying explosives shall be trained in use of fire extinguishers on his vehicle.

(x) If any fire occurs on a vehicle carrying explosives, the driver shall take all practicable steps to ensure that all other traffic is stopped at least 300 m from the vehicle and that all persons in the vicinity are warned of the danger.

(xi) Loading, unloading and handling of explosives shall be supervised by qualified personnel. At the time of loading or unloading of explosives, no electric switch shall be operated.

(xii) Explosives shall not be placed where these may be exposed to flame, excessive heat, sparks or impact.

(xiii) The covers of the explosive cases or packages shall be replaced every time after taking out part of the contents as long as any explosives are left in them.

(xiv) Explosives shall not be carried in the pockets or folds of clothing by any person.

(xv) Primers shall not be made up in a magazine, or near excessive quantity of explosives, or in excess of immediate needs.

(xvi) Nothing shall be inserted in the open end of a blasting cap except fuses.

(xvii) No person shall strike, tamper with, or attempt to remove or investigate the contents of a blasting cap or an electric blasting cap or attempt to pull out the crimped safety fuse out of a blasting cap.

(xviii) No attempt shall be made to soften hard set explosives by heating over a fire or by rolling the explosive on the ground.

(xix) The blasting powder, explosives, detonators, fuses, etc. shall be in good condition and not damaged due to damp moisture or any other cause. They shall be inspected before use and damaged articles shall be discarded totally and removed immediately.

(xx) No attempt shall be made to reclaim or use fuses, blasting caps, electric blasting caps or any other explosives which have been water soaked, even if these have been dried out. The manufacturers shall be consulted for this.

4.6 Storage

(i) The contractor shall construct explosive magazine at his own cost near to power house site.

(ii) The magazine shall, at all times, be kept scrupulously clean. High explosives like dynamite shall be stored in a dry, clean, well-ventilated and fire-proof building constructed in accordance with the relevant Explosives Act, on an isolated Site. The area around the magazine for a distance of 8 m shall be kept clear of all vegetation and combustible matter. There shall be barbed wire fencing and security lights around the magazine and security guards shall be posted for 24 hours to prevent loss or theft of explosives.

(iii) Explosives, detonators and fuse coils shall be stored separately.

(iv) The contractor shall maintain a record of storage and withdrawal of all explosives. This record shall be made available to the Engineer or concerned government authorities. The Engineer and concerned government authorities shall be promptly notified of any loss or theft of explosives.

v) Explosives shall be stored and used chronologically to ensure that the ones received earlier are used first. There shall be sufficient space between the stacks.

(vi) A “make up house” shall be provided at each working place in which cartridges shall be made up by experienced men as required for the Work. All safety measures shall be ensured in the “make up house”.

(vii) Unauthorized persons shall not be allowed at any time to enter the magazine.

(viii) The person-in-charge of the magazine shall, at all times, ensure that the magazine is well and securely locked.

(ix) The magazine, on no account, is to be opened during or on the approach of a thunderstorm and no person shall remain in the vicinity of the magazine during such storm. Sufficient number of lightning conductors shall be provided on top of the magazine.

(x) Magazine shoes, without nails, shall be kept at all times in the magazine, and a wood tub or cement trough, about 30 cms high and 45 cms in diameter, filled with water shall be fixed near the doors of the magazine.

(xi) Persons entering the magazine shall put on the magazine shoes provided for the purpose, and be careful not to allow the magazine shoes to touch the ground outside the clean floor.

(xii) Persons with bare feet shall, before entering the magazine, dip their feet in water, and then step direct from the tub over the barrier (if there is one) on to the clean floor.

(xiii) A brush or broom shall be kept in the lobby of the magazine for cleaning the magazine on each occasion it is opened for the receipt, delivery or inspection of explosives.

(xiv) No matches shall be allowed in a magazine.

(xv) No person having articles of steel or iron on him shall be allowed to enter a magazine.

(xvi) Oily cotton rags, cotton waste and articles liable to spontaneous ignition shall not be taken into a magazine.

(xvii) No tools or implements other than those of copper, brass, gun metal or wood shall be allowed inside the magazine. Tools shall only be used with great gentleness and care.

(xviii) Boxes or explosives shall not be thrown down or dragged along the floor and shall be stacked on wooden trestles. Where there are white ants, the legs of the trestles shall rest in shallow copper, lead or brass bowls, containing water.

(xix) Packages containing explosives shall not be allowed to remain in the sun.

(xx) Empty boxes shall not be stored in the magazine nor let any packing material lie loose.

(xxi) Blasting caps and electric blasting caps shall never be stored in the same box, magazine or building with other explosives.

(xxii) The following shall be hung in the lobby of the magazine:

(a) A copy of these rules;

(b) A statement showing the stock in the magazine; and

(c) Certificate showing the last date of testing of the lightning conductor.

(xxiii) Adequate fire fighting equipment shall be provided in the magazine.

(xxiv) Signboards reading "DANGER HIGH EXPLOSIVES","PROTECTED AREA", "NO SMOKING" etc. shall be conspicuously displayed in front of the magazine.

(xxv) If nitroglycerine from deteriorated explosives has leaked down onto the floor of explosive magazine, the floor shall be desensitized by washing thoroughly with an agent obtained before hand from the supplier of explosives. For this purpose, desensitizing agents and the instructions for using them shall always be obtained alongwith the supply of nitroglycerine.

(xxvi) No explosives shall be stored in the tunnels, galleries, caverns or shafts.

4.7 Disposal of Deteriorated Explosives

All deteriorated explosives shall be disposed off in an approved manner. The quantity of deteriorated explosives, to be disposed off, shall be intimated to the Engineer and appropriate government authority prior to its disposal.

4.8 Drilling

(i) The position of all holes to be drilled shall be marked out with paint.

(ii) All holes shall be of greater diameter than the diameter of the cartridges of explosives used.

(iii) Loading and drilling shall not be carried out at the same time in the same area.

(iv) A drill, bit, or pore shall not be inserted in butts of old holes even if examination fails to disclose explosives.

(v) Drilling shall not be resumed after blasts had been fired until a thorough examination has been made to make sure that there are no unexploded charges which the drills may strike.

(vi) Drilling shall not be started until all remaining butts of old holes are examined for unexploded charges.

(vii) Rock drillers shall be provided with approved respirators in siliceous dusty atmosphere arising out of drilling operations.

4.9 Loading/Charging

(i) The holes shall be cleared of all debris before a cartridge is inserted.

(ii) In loading the holes, tamping shall be done with a wooden mallet having no exposed metal parts.

(iii) Primed cartridges shall be seated by even steady pressure only.

(iv) All loaded holes or charges shall be checked and definitely located before firing.

(v) When holes are sprung, ample time shall be left between spring shots for the holes to cool, and also between the last springing shot and the loading of the main charge.

(vi) When practicable, no more cartridges shall be primed than are required for a round of blasting.

(vii) Detonators shall be inserted only in a hole in the end of a cartridge prepared specially for that purpose.

(viii) Holes in cartridges shall be made with a sharpened wooden stick.

(ix) All charges, before being fired, shall be covered with blasting mats where blasting is done in the vicinity of structures likely to be injured by flying debris.

(x) Detonating cord shall be cut from supply reel before attaching to explosive or tamping in hole. Use of the short pieces of fuse shall be prohibited for detonation purpose.

(xi) No welding shall be done inside the tunnel/cavity at the time of loading of the face, till the blast has been taken.

(xii) Naked flames and lamps shall be kept away at the time of the loading of holes.

(xiii) Such of the electrical lines as could constitute danger for Work of loading/charging shall be removed from the Site.

(xiv) Highly insensitive caps shall be used in case parasite electric current are anticipated within the ground and if lightning is frequent.

4.10 Type of Explosives & Accessories

4.10.1 Explosives

(i) Explosives, banned/restricted in any form by the Govt. of Nepal shall not be used for the purpose of blasting.

(ii) Only class-II explosive shall be used. These explosives shall be of safe to handle and use, exhibit water resistance and liberate low volumes of noxious gases.

(iii) Manual Mixing of chemicals to form any explosives shall not take place and such explosives shall not be used.

(iv) Any Explosives having shelf life less than 6 months shall not be used.

(v) Explosives being used shall be capable of performing in low temperatures.

4.10.2 Detonators

(i) Priming of the explosives shall be done only with Non-electric detonators with shock tune containing fine spray of around 13-16 mg/m HMX/AL powder.

(ii) The detonators shall be truly Non-electric in nature.

(iii) The shock tube shall be of the nature that the color of the tube remains unchanged post blast and can be located easily for misfires etc.

(iv) Identification tag and J-hook shall be placed at the end of the tube for identification and easy connectivity respectively.

(v) Ultrasonic seal shall be provided at the end of the tube to make it water proof.

(vi) Shelf life of the detonators shall be a minimum of 1 year.

(vii) Non-electric detonators shall be safe against stray currents, static electricity, Radio-frequency energies and accidental initiation by impact, shock, friction and time as per the standards fixed by the appropriate authority.

(viii) The delay range of detonators should comprise of a minimum 0-15 delays firing completely in not less than 8000 ms for long period detonators.

(ix) Short delay series shall contain a nominal delay interval of 25 ms.

(x) Electric detonators shall not be used except for the initiation of Detonating Fuse.

4.10.3 Detonating Fuse/Safety Fuse

(i) Detonating Fuse shall be used for connecting Non-electric detonators.

(ii) Nominal Weight of PETN shall be 10 g/m.

(iii) Detonating Fuse shall be able to get initiated by no. 6 detonators.

(iv) Water resistance shall be excellent.

(v) Safety fuse shall be used only to initiate the plain detonators.

4.11 Wiring

(i) All electric caps in a blast shall be of the same manufacture.

(ii) Each electric blasting cap shall be tested with an approved galvanometer before and after tamping in a hole to determine whether it will carry the current. All testing shall be done away from the heading face.

(iii) After testing the leg wires of electric blasting caps, they shall be short circuited by twisting the bare ends together and shall remain so twisted until ready to be connected into the circuit prior to connecting to the firing line.

(iv) Unless, the power supply is heavy, it is recommended that all electric blasting caps shall be wired in series and the firing line shall not be smaller than No.14B and S-gauge copper wire.

(v) The number of electric blasting caps used in a circuit shall not exceed the tested capacity of the blasting machine.

(vi) The circuit, including all caps, shall be tested with a circuit tester or galvanometer, operating accurately, before being connected to the firing line.

(vii) Cartridges shall not be primed nor holes loaded during the approach of a thunderstorm or while it is in progress. If a charge has been primed or holes loaded, every person shall be ordered to a safe distance until the storm is over.

(viii) Blasting circuit wires shall never touch other wires carrying electric current.

(ix) Blasting operation control shall consist of two switches, a safety switch and a firing switch located at least 2 meters apart, the connection between the switches to be made by a 'Plug-in' jumper which may be permanently attached to the safety switch. The 'Plug-in' jumper is so made that it cannot be plugged into or connected to the firing switch until the firing switch is unlocked, and the jumper must be disconnected from the firing switch before the firing switch can be locked.

(x) Both the safety switch and the firing switch shall be of the locking, double pole, double throw type which, when opened and locked in downward position short circuit and ground the leading wires.

(xi) Both the switches shall be locked immediately after firing the shot and before any person is allowed to return to the area. Keys to the switches shall remain in the possession of the starter at all times.

4.12 Fuse Blasting

(i) The length of fuse to be used in blasting shall in no case, be less than 75 cm or that required by the Engineer.

(ii) Blasters or shot firers shall be cautioned always to use sufficient lengths of fuse to permit them to reach a safe place before the first hole is fired.

(iii) Not more than 12 holes shall be loaded and shot at one time if cap and fuse are used to detonate the charge.

(iv) Mud cap blasting being insufficient and dangerous shall be avoided. Two or more mud caps shall not be placed on one rock except when electrically detonated.

4.13 Firing

(i) Shots shall, so far as practicable, be fired electrically and only apparatus especially designed for the purpose shall be used. Power lines shall not be

tapped for the purpose. No shot shall be fired except by a licentiate blaster authorized by the Engineer.

(ii) The charge shall be fired, successively and not simultaneously.

(iii) Prior to the firing of a shot, all persons in the blasting area shall be warned of the blast and ordered to a safe distance from the area.

(iv) Competent flagmen, equipped with red flags and whistles shall be posted to stop traffic at access points on each possible route of travel, to the vicinity of the blasting area.

(v) Blasting shall be done at fixed hours approved by the Engineer and the blasting times shall be displayed on a Notice-Board.

(vi) Order to fire shall be given only by the Supervisor-in-Charge of the work after giving three warning signals to enable all the workmen to reach safe shelters.

(vii) Blasts shall not be fired until it is absolutely certain that every person has retreated to a safe distance.

(viii) The person-in-charge of blasting shall be the last one to leave the area to be blasted.

(ix) A siren with a distinctive note shall be used to give warning signals. This bugle shall not be used for any other purpose. All the labour shall be made acquainted with the sound of the bugle and shall be strictly warned to leave their Sites of Work immediately for safe shelters at the first warning signal and not to leave the shelters till all clear signal has been given.

(x) An all clear signal shall be given when the blasting is over.

(xi) Definite places of shelter, natural or artificially constructed, shall be assigned to the crew. Workers shall be made to go to these shelters rather than trust each other's judgment about a safe place.

(xii) In special cases, suitable extra precautions shall be taken. The Engineer may, however, permit blasting for underground excavation without restriction of fixed time provided he is satisfied that proper precautions are being taken and that the Work of other agencies on the Site is not unduly hampered.

(xiii) Only Supervisor-in-Charge shall be responsible for the safe custody of the firing apparatus.

(xiv) For blasts in series, only detonators of the same brand and same electrical resistance shall be used. All detonators shall be checked before use.

(xv) The firing cables shall be with a proper insulating cover to avoid short circuiting due to coming in contact with water, metallic parts or rock.

(xvi) Use of earth as a return line shall not be permitted.

(xvii) The firing cable shall be connected to the source of current only when nobody is in the area of blasting.

(xviii) Mats or rubber tyres tied together with rope shall be used as protection from flying debris to cover the charges where blasting may expose persons or property to injury or damage.

(xix) Blasting shall be permitted only after adequate provisions have been made for the protection of persons, the Works, and public and private property. The Engineer's approval of any of the contractor's blasting operations shall not relieve the contractor of his sole responsibility for the safety of persons and property. Any damage done to the works or property by blasting shall be repaired by the contractor.

4.14 Inspection after Blasting (Misfire Drill)

(i) Immediately after a blast has been fired, the firing line shall be disconnected from the blasting or other source of power.

(ii) After a blast has been fired, a careful inspection shall be made by the blaster to determine if all charges have been exploded. The blaster shall count the number of the exploding shots in blasting. Misfires in fuse blasting shall not be examined for a sufficient time after its failure to explode.

(iii) Electric blasting misfires shall not be examined for at least 15 minutes after failure to explode. Other persons shall not be allowed to return to the area of blast until an "All Clear" signal is given.

(iv) All wires shall be carefully traced and search made for any unexploded cartridges by the person-in-charge of the blasting operation.

(v) Loose pieces of rock and other debris shall be scaled down from the sides of the face of excavation and the area made safe before proceeding with the Work.

4.15 Misfires

(i) Misfired holes shall be placed in the charge of a competent person.

(ii) If broken wires, faulty connections, or short circuits are determined as the cause of a misfire, proper repairs shall be made, the firing line reconnected, and the charge fired. This shall be done, however, only after a careful inspection has been made of burdens remaining in such holes and no hole shall be so fired when the burden has been dangerously weakened by other shots.

(iii) The charge of explosives from a misfired hole shall not be drilled, bored or picked out.

(iv) Misfired charges tamped with solid material shall be detonated by the following method:

(a) Float out the stemming by use of a water or air jet from hose until hole has been opened to within 60 cm of charge;

(b) Water shall be siphoned off or pumped out;

(c) New charge shall be placed and detonated.

Whenever this method is not practicable, then a new parallel hole, not nearer than 60 cms, shall be drilled, loaded and detonated. A careful search shall be made of unexploded material in the debris of the second stage.

(v) If misfire has been found to be due to defective detonators or dynamite, whole quantity or box from which the defective article was taken must be withdrawn from the work site for return to the manufacturer or destruction as decided by the Engineer.

(vi) The contractor shall report, in writing, to the Engineer, all cases of misfire, causes of the same and steps taken in connection therewith.

4.16 Blasting for Underground Works

(i) Only electric blasting shall be adopted for tunnel and underground cavities.

(ii) A separate circuit, independent of power and light circuit, shall be used for blasting.

(iii) No electrically energized circuit shall be installed on the same side of the tunnel, or cavity with the blasting circuits.

(iv) All electric lights or other energized circuits shall be disconnected for at least 70 meters from the point of loading.

(v) All tracks, airlines and vent pipes shall be kept properly grounded.

(vi) For loading purposes, the employees shall be equipped with permissible battery lamps.

(vii) Switches shall be as specified in Para-4.11(ix) hereof. The safety switch and the firing switch shall be placed on opposite sides of the tunnel/cavity.

(viii) Only explosives which produce less than 0.005 m^3 of poisonous gas (Carbon monoxide and Hydrogen sulphide) per 31.5 mm x 200 mm cartridge shall be used for Underground Works.

(ix) No fire, flame, smoking or open lights shall be allowed within 6 metres from any explosive except for the purpose of firing a charge.

(x) Adequate warning notices shall be given to all persons employed indicating the period of danger at the time of firing and it shall be the duty of the contractor to

provide adequate shelters or screens for protection of workers exposed to risk of injury from the explosion or from flying material.

(xi) After the blast takes place in underground works the workmen shall not be allowed to go to the face till all the toxic gases are evacuated from the face.

4.17 Underwater Blasting

(i) Only water resistant blasting caps and detonating cords shall be used in underwater blasting operations.

(ii) Loading tubes and casings of dissimilar metals shall not be permitted because of possible electrical transient current from galvanic action.

(iii) When more than one charge is placed underwater, a float device shall be attached to an element of each charge in such manner that it will be released by the firing.

(iv) No drilling, digging or excavation shall be permitted until all misfires have detonated or the explosives are removed from the missed holes.

4.18 Monitoring of Blasts

4.18.1 General

(i) The contractor shall supply and operate Seismometer or Seismograph approved by Engineer at each blasting site to measure 3-components of ground vibration and air blast overpressure. The equipment shall have sufficient memory space to store at least 300 events and shall be equipped to measure wide range of ground vibration and airblast overpressure. It shall also be equipped with a microphone attachment, permanent paper trace output with built-in strip chart printer, LCD display and PC retrieval attachment for data to be used as and where directed by Engineer to monitor blasting work.

(ii) Unless otherwise agreed in writing by Engineer, trial blasts, initial blasting in general, initial blasts in new areas and blasts adjacent to completed concrete structures and sensitive areas shall be monitored. For structures in the proximity of blasting the peak particle velocity shall be measured at the locations immediately adjacent to the structure nearest to the face being stated or another location where it is necessary to limit vibration. Apart from monitoring on its own the contractor has to provide supports for measurement to other agencies appointed by Engineer. In tunnel excavation, monitoring shall specially be undertaken with change in rock mass, in shallow cover zone and or as directed by Engineer.

(iii) The measured vibration results shall be transmitted to Engineer together with all the useful information concering the completed information (cut of the face/slope

or the cutting face; particle size distribution of the excavated material etc.; drill marks; vibration wave form in three directions-radial, transverse & vertical; air overpressure waveform; print out of Peak Particle Velocity (PPV) and associated predominant frequency in each direction).

(iv) Assistance shall be taken from blasting consultants/experts as specified in Quality Manual document.

(v) In case the defined thresholds be exceeded, blasting operations shall be stopped in order to finalize the new blasting pattern or the choice of another methods of proceeding with the excavations.

(vi) In general the methods, parameters to be measured and equipment for measurement of vibration shall be in accordance with IS: 14881 unless otherwise specified.

4.18.2 Restriction of Blasting

All blasting works shall be completed before pouring the first structural concrete, unless otherwise specifically agreed by Engineer in writing.

When excavation are carried out using explosives, the contractor shall arrange his excavation and concrete placing programmed so that, as far as practicable, it shall not be necessary to use explosives close to permanent construction.

The contractor shall be responsible for avoiding damage to adjacent structures from fly rock by erecting barricades and/or the use of blast mats or other means by installing shielding device acceptable to Engineer.

The maximum allowable limit of noise overpressure in blasting shall not exceed 133 dB. It must be measured close to the structure to be protected from blasting.

Ground vibration induced by blasting shall be measured in terms of the Maximum or Peak Particle Velocity (PPV) in mm/sec and predominant frequency of the ground vibration.

The following limits on peak particle velocity are given as a guide and may be modified by Engineer on the basis of seismograph records and observations during the progress of works.

(i) For structures concreted less than 60 hours before, the peak particle velocity shall not exceed 10mm/second or else no blasting shall be authorized within 30 metres of concrete in place.

(ii) For structures concreted more than 60 hours before, the peak particle velocity shall not exceed 50 mm /second for soil weathered and soft rock and 70 mm /second for hard rock measured at the surface of the material concerned

(iii) For existing structures adjacent to excavation areas, including structures of following types

- Not forming part of the contract
- belonging to owner and
- not belonging to owner,

The frequency and peak particle velocity dependent safety criteria as per Director General of Mines Safety(DGMS), Govt. of India/ relevant Govt. of Nepal authority criteria shall be followed.

(iv) Engineer may request to limit particle velocity at 10mm / second for high structures, even if they were concreted more than 60 hours ago.

Where circumstances dictate, such as when blasting adjacent to partially cured concrete, the peak particle velocity permitted be reduced by Engineer.

For specific structures and if requested by Engineer, the contractor shall fulfill the following criteria:

- at a 20 m radius of the blast, the intestitial velocity, for frequencies inferior to 100 Hertz, shall be limited to 4 centimeters per second (40 mm/sec),
- after blasting, 80% of the bore holes must be visible.
- pre-splitting is mandatory,
- bore holes space is 45 cm maximum

If necessary, Engineer may require the contractor to restore at his own expense any building, structure, masonry and equipment damaged by blasting, through direct or indirect effects.

4.18.3 Recording Blasting Operations

The contractor shall keep records of all blasting carried out showing the time and location of each blast, the type and amount of explosive used, together with any other relevant data in an agreed format approved by Engineer.

During the site works, as mentioned before each blasting pattern shall be submitted to Engineer for approval at least 24 hours before the blasting operation is due to begin. This shall be in the form of a presentation sheet setting out all the information concerning:

- the type(s) of explosives to be used
- the x,y,z coordinates of each firing holes and the firing polygonal

- the diameter, depth, charge and the packing of each hole
- the method of ignition and the type of detonator for each charge,
- if using a sequential exploder, the connection of the different lines and a plan showing the effective delays of the charges,
- the total quantity of explosives for the firing or the round.

At all times, Engineer shall be able to interrupt the explosive operation or request the contractor to modify the blasting patterns and the responsibility and the costs to be borne by the contractor.

4.19 Measurement and Payments

(i) No separate measurement and payment shall be made for furnishing safe blast reports & their time to time updation from reputed institution as approved by Engineer, supply of blasting material, its safe storage, drilling of holes, loading of blasting material, all blasting operations including monitoring etc. which is deemed to be included in the Unit Rate of excavation and other relevant items.

(ii) Any repair work or any indemnities required due to contractor's non-compliance with the safety requirements shall be at the contractor's expense.

(iii) No separate measurement/payment shall be made due to use of extra explosive on account of change in rock type.

CHAPTER – 5

SURFACE/OPEN EXCAVATION

INDEX

5.1 Scope of Work

(i) The specifications described herein-under relate to the work of open excavation and shall include all labour, tools, plants, constructional plant and services, necessary to carry out the excavation of different materials, transportation and stockpiling/disposal of all excavated materials into stockpiles/dumping areas as approved by the Engineer.

(ii) Excavation shall be made to the lines, grades and dimensions shown on the drawings or as otherwise directed by the Engineer.

(iii) The contractor shall maintain the excavated slopes, drainage, trenches and prepare foundations as shown on the drawings or as required by the Engineer.

(iv) The area of open excavation shall, wherein the opinion of the Engineer, clearing is necessary, be cleared of all trees, bushes, rubbish and other objectionable matter and the materials so removed, shall be burnt or otherwise disposed off as directed by the Engineer.

(v) When additional excavation outside the lines and grades shown on the drawings is required by the contractor for his own convenience, such additional excavation shall be required to be backfilled with acceptable material and compacted by the contractor in a manner satisfactory to the Engineer. The contractor shall submit his plans for such proposed work in writing for Engineer's acceptance prior to the commencement of the work.

(vi) The removal of mud and slush resulting from heavy rains or flooding of the sites, when necessary to ensure the safe and effective performance of the Work, shall be performed by the contractor.

(vii) At all times during construction, the contractor shall adopt excavation procedures such that at no time shall the stability of any slope be impaired.

(viii) The works include processing if required, placing and spreading, compaction, sprinkling with water as needed for the materials specified.

(ix) The approval given by the Engineer to the contractor's methods and equipment shall not relieve the contractor of his full responsibility for a proper and safe execution of excavations, or of liability for injuries to, or death of persons, or any obligations under this Contract.

(x) The contractor shall comply with all safety procedures and requirements as stipulated in the Chapter-Safety Precautions.

5.2 Submittals

(i) At least 45 days prior to the commencement of excavation, the contractor shall submit details of his excavating methods and sequences for all open excavation works including the equipment.

(ii) The description of drilling and blasting procedures shall include the following:

(a) Location and areas of blast.

(b) Diameter, spacing, depth, pattern and orientation of blast holes.

(c) Type, strength, amount and distribution of explosives to be used per hole.

(d) Description and purpose of any special method to be adopted by the contractor.

(e) Sequence of various activities of the excavation work with an indication of corresponding time requirements.

(iii) At least 21 days prior to dumping or stockpiling of any material, the contractor shall submit the layout of the spoil and stockpile areas, which shall be within the areas indicated on the bid drawings. All pertinent data of working methods and provisions for the security, stability and temporary and permanent drainage of the areas shall be included along with details of volumes, material types, heights and grades provided.

(iv) To enable the Engineer to verify all necessary setting out and elevations carried out by the contractor, the latter shall notify the Engineer in writing, giving at least 7 days notice of his intentions to start excavation.

(v) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

(vi) Prior to starting any excavation in any particular area, the contractor shall confirm in writing his agreement with the existing surveys and topographical data showing the original ground surface for the area in question which will be used for measurement purpose. Should the contractor have any doubts as to the correctness or sufficiency of such data, he shall carry out an independent survey on his own hand and submit his survey to the Engineer for approval. In case of disagreement the Engineer and contractor shall mutually review the existing data. The agreement concerning the location of the original ground surface must be reached before commencing excavation work. Contractor's failure to follow the procedure outlined above will forfeit his right to claim any other locations of the original ground surface than that established by the Engineer.

(vii) To enable the Engineer to verify all necessary elevations and cross sections of the original ground surface prepared by the contractor, the latter shall notify the Engineer in writing, giving at least seven days notice before the commencement of any excavation. The contractor shall clear, in advance, all vegetation that may interfere with this survey work.

(viii) The contractor shall submit and agree with the Engineer a monitoring plan for the excavation to observe potential or actual movement of the slopes excavated in the rock. This plan shall also give details of the procedures and equipment to be employed by the contractor to stabilize or protect as quickly as possible any areas in which it is determined that untoward movement or deformation is occurring or is threatened.

5.3 Setting out

(i) The contractor shall establish, at suitable points, to the satisfaction of the Engineer permanent reference marks on the center lines, as may be necessary and directed. The permanent marks shall be inscribed on bronze pegs, set in concrete blocks where they will be free from any likelihood of disturbance. Suitable bench marks shall be established.

(ii) As the Work progresses, center line marks shall be made on pegs, inserted at convenient intervals to the satisfaction of the Engineer, for checking alignment, grades, levels etc. The contractor shall at all times, remain responsible for the sufficiency and accuracy of all such bench marks and reference points.

(iii) The contractor shall be responsible for setting-out all the structures and slopes as shown on the construction drawings. All extra work and over excavation caused by improper setting-out by the contractor shall be corrected by himself immediately as directed by the Engineer at no cost to the Employer.

5.4 Accuracy of Alignment, Grades and Levels etc.

(i) Bench marks and fixed reference points with the value of the levels and the co-ordinates, will be fixed by the Engineer in the work areas. The plans showing the position, co-ordinates and the levels of the salient points will be supplied to the contractor.

(ii) The contractor shall take all precautions to ensure that the points fixed by the Engineer are not disturbed by his Work and shall make good the damage, if any.

(iii) The contractor shall provide all facilities like labour, instruments, etc. and all co-operations to the Engineer to check the alignments, grades, levels etc. whenever and every time they are asked for.

(iv) Any discrepancy or error detected during the course of excavations and/or at the end of Work shall be set right by the contractor, in a manner satisfactory to the Engineer.

5.5 Classifications of Excavation

All materials to be excavated shall be classified by the Engineer in the presence of the contractor into one of the following items:

5.5.1 Loose Excavation and Ripping

Loose excavation shall include all types of soil, i.e. organic top soil, clay, silt, sand, gravel, soft and hard moorum, soft rock and such other material, which can be excavated manually by ordinary pick and shovel or barring and

wedging or by mechanical equipment such as tractor blade, ripper power shovel and dragline but without recourse to blasting. It shall also include embedded boulders, not bigger than one meter in any one direction.

5.5.2 Rock Excavation

(i) Rock excavation shall include all rock which cannot be excavated without prior blasting to loosen the same.

(ii) The term rock shall include boulders and detached rock blocks larger than one meter in any one direction. It shall also include the removal of softer materials, lying between layers of rock.

5.5.3 Dental Excavation

a) Dental excavation shall include the removal of unsuitable material from shear zones, clay seams, pockets, joints, caverns, or from spaces between boulders beyond the lines of excavation shown on the construction drawing or established in the field, which are too small to be excavated by common earth moving equipment.

b) Dental excavation, depending on its extent, will require the use of a back-hoe, hand tool, or other small excavating equipments, as well as the use of a high velocity air water jet. The methods employed shall be such as to avoid fracturing of the rock adjacent to the material being removed.

c) Dental excavation shall be performed where directed. The extent, to which such material shall be removed, including the depth, direction, and dimension of the work, will be determined by the Engineer. In general, however, excavation into cracks or seams shall be to the depth that is a minimum of three times the seam width, and such excavation shall be backfilled with concrete or shotcrete. No blasting will be permitted.

5.6 Removing Bluffs and Loose Rock

All loose boulders, semi-detached rocks (alongwith the earthy stuff which might move therewith) not directly in excavation but so close to the area to be excavated, as to be liable in the opinion of the Engineer, to fall or otherwise endanger the workmen, equipment or the work, shall be stripped and removed from the areas of excavation. The methods used shall be such as not to shatter or render unstable or unsafe any rock that was originally sound and safe. Any material not requiring removal as contemplated in the work but which, in the opinion of the Engineer, is likely to become loosened or unstable later on, shall also be promptly and satisfactorily removed, as directed by the Engineer.

5.7 Excavation in Open Cuts

(i) The side slopes in excavation shall be as shown on the drawings or as directed by the Engineer.

(ii) If the contractor feels that the slopes as shown on the drawings are unsafe, he shall make a fresh proposal and submit to the Engineer for approval before starting such excavation.

(iii) Every precaution shall be taken to prevent slips. In case slips occur, the slipped material shall be removed to the designed (modified) slope. The contractor shall ensure that slip should not occur due the fault of contractor's representative. Engineer's decision in this regard shall be final and binding.

(iv) Suitable berms shall be left at appropriate places with necessary approach ramps and sump pits for installation of dewatering pumps or other purpose, as required by the Engineer. These shall be excavated and the excavation finished to lines and grades shown on the drawings and to the satisfaction of the Engineer.

(v) In case of loose excavation, where the surface is left as excavated, or is to be covered by pitching, formation of rain cuts and gullies shall be avoided by proper drainages. Any gullies formed shall be made good by properly packing excavated rock spoil in them. All holes left by removing boulders shall also be filled in with rock spoil.

(vi) Where plain surfaces are required, such faces of excavation shall be formed in such a manner as would least shatter the rock mass. Only light blasting or ream holes or similar methods shall be allowed in areas adjacent to such faces.

(vii) **Line drilling**

(a) Line drilling shall be used where control perimeter blasting may cause excessive damage to the surrounding rock or where there are structures adjacent to the excavation as mentioned in drawings or as directed by the Engineer.

(b) Line-drilling is drilling of closed spaced holes along the neat excavation line. These will form a surface of weakness to which the primary blast can break. Light blasting with well-distributed charges fired after the main excavation is removed may be permitted in the holes. If, however, in the opinion of the Engineer the blasting may injure the rock, the–use of explosives shall be discontinued and the excavation shall be completed by broaching, wedging, or barring.

(viii) All excavation, done beyond the lines and dimensions shown on the drawings, which are to be covered by concrete, shall be filled back with the concrete of the same quality or as directed by the Engineer.

(ix) The open cut excavation shall be staged as shown on the drawings or as required by the Engineer.

(x) The contractor shall carry out the excavation of open cut rock slopes utilizing the controlled perimeter blasting technique wherever required by the Engineer.

(xi) Where depth of open rock excavation is more than 10m, the excavation shall be carried out in a descending way, from horizontal berms, by benching.

(xii) After scaling to the satisfaction of Engineer and prior to the excavation of the next bench, the contractor shall install rock bolts, provide wiremesh, shotcrete and temporary relief holes if considered necessary, as shown on the drawings or as required by the Engineer.

(xiii) All blasted rock shall be removed from the bench toe before undertaking further work.

(xiv) All other specifications pertaining to blasting and scaling etc relevant to open excavation as stipulated in Chapter-Explosives and Blasting of these documents shall be referred.

(xv) Contractor shall regularly monitor and inspect all excavations made under this contract, and shall forthwith promptly remove and dispose of any rock which deems loose, unsound or disintegrated, or in any other way unsafe.

(xvi) While carrying out excavation for the foundations of the structures, if it is considered necessary for a particular work and if approved by the Engineer, the sides of the loose excavation shall be shored and strutted to the satisfaction of the Engineer.

(xvii) The rock excavation in foundations of structures shall be carried out to the depths as shown on the drawings. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines of required excavation. The quantity and strength of explosives used in the foundation excavation in rock in various locations shall be such that they will neither damage nor crack the rock outside the limits of excavation.

(xviii) All excavation done beyond the lines and dimensions shown on the drawings, shall be backfilled with concrete of the same quality as that for the foundation or as directed by the Engineer.

5.8 Excavation Clean up and Preparation of Foundation

(i) After completion of excavation of foundation trimming for the final removal of all dummy rock or loosened mass, shall be done by chiseling, barring and wedging as directed by the Engineer.

(ii) Any weathered or decomposed rock remaining shall be removed. Open fissures, joints, crevasses and any other doubtful areas shall be cleaned to a suitable depth and to firm rock on sides.

(iii) Contractor shall wash all rock surfaces of the excavations. This washing shall be carried out initially for inspections when required by the Engineer.

(iv) Final washing of any section of the work prior to concreting or application of shotcrete shall be carried out only when the blasting for the excavation and removal of projections inside the neat lines has been completed.

(v) Final washing prior to concreting shall be done by directing a stream of water at a pressure of about 8 to 10 bars on the rock surfaces from a distance of 1.5m through a nozzle of 18mm diameter so as to remove all loose rock, fragments, dust and debris from the surfaces.

(vi) Foundation excavation shall be kept well drained and free of standing water. The contractor shall provide all necessary drains, ditches and sumps, and use pumps when necessary; in order to ensure that foundation surfaces are not harmed by water. When foundations are thus affected, the affected material shall be removed and replaced with approved backfill.

5.9 Disposal of Excavated Materials

(i) The excavated materials suitable for construction shall be stockpiled at appropriate locations.

(ii) Excavated materials which are not suitable for construction and those in excess of the requirement for construction shall be disposed off in the waste disposal areas as required by the Engineer. Prior to the commencement of excavation work, the contractor shall have prepared the disposal area i/c providing of retaining/breast walls to the satisfaction of Engineer and methods proposed for disposal shall also have received approval of Engineer. Surfaces of material so disposed off shall be trimmed to regular lines and grades satisfactory to the Engineer. Disposal of all materials shall be such that it will not interfere with natural drainage or with Engineer's acceptance; drains will be constructed to prevent the undesirable accumulation of water in or around the disposal area. If additional areas are required, the contractor shall propose such areas for approval of the Engineer.

(iii) The contractor shall ensure that no excavated materials are disposed off in the streams or at locations, where in the opinion of the Engineer, these are liable to be washed away by the floods.

(iv) All other specifications/stipulations in this regard laid in Para-6.11 of Chapter -Underground Excavation of these documents shall also apply.

(v) Excavated materials shall be transported to the disposal areas in such a way that spillage onto roads etc. is avoided. Any material which, despite the contractor taking reasonable care, does fall onto roads etc. shall be promptly cleared and removed by the contractor.

(vi) The contractor shall be liable for any damage to temporary or permanent works or to third parties and their property caused by inadequate drainage of the spoil or stockpile areas.

(vii) Payment for retaining wall/breast wall in dumping area shall be regulated as per Chapter-Environment Protection Measures.

5.10 Drainage

Seepage water from springs or rain water shall be suitably collected and drained away by gravity, wherever it is possible to do so. Where, however, drainage by gravity is not feasible, pumping could be resorted to. All stipulations laid down in Chapter-Dewatering, Drainage and Pumping shall be followed.

5.11 Backfill

(i) Backfill shall consist of materials as approved by the Engineer and shall be placed in locations as shown on the drawings or as directed by the Engineer.

(ii) Earth fill, which, on account of its nature or locations requires no compaction, shall be classified as backfill.

(iii) Backfill which shall be compacted by means of roller, mechanical or manual tampers is classified as compacted backfill.

(iv) At locations where areas to be backfilled are too small or confined, compaction by hand or by the use of hammers may be allowed by the Engineer.

(v) Only suitable materials obtained from excavation, if practicable, shall be used for backfill and construction of such features as cofferdams, embankment, guide banks, afflux bunds and similar structures.

(vi) Material to be used in backfill shall be free draining type.

(vii) Payment will be made for back fill in accordance with the rate entered in Bill of Quantity.

5.12 Illumination

The contractor shall install an adequate illumination system on the work sites as stipulated in Chapter-Site Installations and Services.

5.13 Protection of work site from River

5.13.1 General

(i) The contractor shall be responsible for the maintenance and safety of the structures to be constructed at headworks closer to the river by constructing temporary protection walls, temporary bunds/dykes and all other appurtenant works required for completion of head pond. He shall also be responsible for the maintenance of construction site, removal of the temporary protection works and shall repair or replace defects if any. The contractor shall indemnify the Engineer against claims arising out of any such failure, made by a third party.

(ii) Not less than 60 days prior to the commencement of any operations, the Contractor shall submit to the Engineer for approval, details of the proposed methods, procedures, and equipment that he intends to use for the head pond and appurtenant structures.

5.14 Measurements and Payments

5.14.1 General

(i) Measurement for payment for any class of open excavation will be made of the materials excavated in each class and will be in-situ as measured from survey performed prior to start of work and the lines and grades shown on construction drawings or directed by Engineer.

(ii) Payment will be made for relevant class of excavation at the appropriate unit rate entered in the BOQ which shall include entire cost involved complete in all respect.

(iii) The estimated quantities for each excavation class given in the Bill of Quantities are not to be considered as an accurate indication of the quantity of work since the predicted classification of excavation may differ during the course of the work.

(iv) The unit rates, if not specifically stipulated otherwise, shall be deemed to include the entire cost of, but not limited to, the following:

a) Provision of all labour, equipment and materials required for open excavation in various locations including drilling holes for blasting, developing and improving controlled blasting methods, performance of blasting, cleaning, washing, protection and maintaining excavated surfaces in satisfactory conditions and additional excavations if any, required by the contractor for his construction methods.

b) Provisions for loading, hauling and dumping the excavated material on stockpiles, dumping areas or points of incorporation into permanent works upto 1km from the site of excavation, shaping and trimming of the excavated materials in the dumping areas as specified, clearing of the stockpile areas, formation and maintenance of stockpiles, re-handling of suitable materials including segregating, grading, draining and drying of materials suitable for use in embankment construction or as backfill.

c) All delays during excavation work resulting from installation of rock supports, stabilization and protection works required by the geotechnical conditions of the material encountered.

d) Complying with all requirements of statutory laws and regulations relating to the works and any restrictions resulting therefrom, obtaining all necessary permits and licenses for the purchase, use, storage and transport of explosives and other material.

e) Surveying, setting out, checking of excavated profile, layouts and any subsequent rectification works resulting from undue or incorrect

surveys, provision of suitable equipment for, and delays due to carrying out this work.

f) Furnishing, installation, operation, maintenance and removal of communication and illumination systems and observing safety precautions.

g) Recording and preparation of reports related to excavation progress and procedures.

h) All work involved with and any partial or short interruptions or inconvenience caused by the check surveys, performance or the rock mechanics tests, installation and monitoring of instruments and geological mapping, for which no separate payment is provided elsewhere in these specifications.

i) Seepage water or rainwater suitably collected and drained away by gravity.

(v) Extra payment will be made for:

(a) Hauling the excavated materials beyond 1 km from the site of excavation. Measurement for payment will be based on the in-situ volume multiplied by the actual distance in excess of 1 km from the site of excavation. Payment for such volume will be made at the Unit Rate as entered in the Bill of Quantity. Average distance will be measured from dumping area.

(b) Construction of retaining structures in dumping areas or other protection walls directed by engineer.

5.14.1.1 Line drilling

(i) Measurement for payment for line drilling will be of the length of the holes actually drilled into the rock along the side of the excavation as mentioned in drawings or as directed by the Engineer.

(ii) Payment will be made at the unit price per meter of the drill hole irrespective of the diameter, entered in the Bill of Quantity, which shall include the entire cost of drilling the holes, light blasting, broaching, wedging, barring or other methods used in conjunction with line drilling.

5.14.2 Loose Excavation & Ripping and Rock Excavation & Dental Excavation

(i) Measurement for payment for each class of excavation will be of the in-situ volume defined by the excavation lines as shown on the drawings, unless otherwise modified or directed by the Engineer.

(ii) The volume of excavation in each class of material will be worked out from the areas of cross-sections and no distinction will be made whether the material is dry or wet. No deduction for voids will be made.

(iii) Cross sections will be taken normal to the centre line at as close intervals as practicable but, in any case, not more than 5 meter and 3 meter apart in loose excavation and rock respectively, prior to the starting of excavation in each class of material, unless some other method is acceptable to the Engineer in any particular location of the work.

(iv) Payment will be made at the appropriate Unit Rate for each class entered in the Bill of Quantities which shall include the entire cost of:

(a) Drilling holes for blasting

(b) Developing and improving controlled blasting methods

(c) Blasting tests, explosives and performance of blasting.

(v) Measurement for payment and payment for removal of bluffs and loose rock close to the areas to be excavated will be made at the Unit Rate entered in the Bill of Quantities.

(vi) Measurement for payment and payment for removal of unavoidable slips which may occur in the excavated slopes will be made at the Unit Rate entered in the Bill of Quantities for loading, hauling up to 1 km from site of work, dumping of material and cleaning of surface.

5.14.3 Shoring and Strutting

(i) Measurement for payment for shoring and strutting will be of the excavated area shored and strutted, as shown on the drawings or as otherwise directed by the Engineer.

(ii) Payment for shoring and strutting will be made at the Unit Rate entered in the Bill of Quantities which shall include the entire cost of all labour, materials and equipment required for fabricating, erecting, maintaining in position and removal of the shoring and strutting.

5.14.4 Backfill

Measurement for backfill will be made for the volume of backfill placed and payment shall be made at the unit rate entered in the Bill of Quantities.

5.14.5 Exclusions

(i) All costs for dewatering shall be covered by the applicable Unit Rates as specified in Chapter “Dewatering, Drainage and Pumping”.

(ii) Excavation for drainage trenches will be excluded from the measurements for excavation. Measurements for payment and payment are separately specified in Chapter-Dewatering, Drainage and Pumping.

5.14.6 No Measurement for Payment or Payment will be made for the Following:

(i) Clearing of all trees, bushes, rubbish and any other objectionable materials and their removal and disposal of the same.

(ii) Over excavation due to negligence of contractor beyond the excavation lines shown on the drawings, removal of material or backfilling with concrete or acceptable material and compaction where and when as required by the Engineer.

(iii) Replacement of survey points fixed by the Engineer which are damaged by contractor's negligence.

(iv) Formation of berms of ramps, sump pits for installation of dewatering pumps at places which fall beyond the specified excavation lines.

(v) Treatment of rain cuts, gullies and holes left by removal of boulders by properly packing with excavated rock spoil.

(vi) Methods adopted for specially controlled excavation at foundation level or near the faces where plain surfaces are required .

(vii) Replacement or repair of concrete or other works damaged by blasting.

(viii) Working of all rock surfaces of excavation when required by the Engineer.

(ix) Installation of water measuring devices and measurement of discharges.

(x) Additional work of removing materials and backfilling voids with approved material where over excavation occurs due to contractor's working method or negligence.

(xi) Over-excavation required for contractor's convenience. The concrete required to fill such excavation shall also be at the contractor's expense.

(xii) Draining, shaping and trimming of the dumped material in waste disposal areas to the lines and grades as directed or approved by the Engineer. The cost of protection works like wire crates, retaining walls shall however be paid separately.

(xiii) Removal of slush, debris and any type of inflow material brought by flood or river water necessitating re-excavation of already excavated sections. Excavation for foundation or trenches or any other sections shall be paid only once.

(xiv) Construction of temporary protection walls, temporary bunds/dykes required for completion of head pond.

(xv) Removal of the temporary protection works and shall repair or replace defects if any.

(xvi) Stockpiling of construction materials from required excavations materials which cannot be incorporated directly into permanent works.

(xvii) Any additional excavation carried out by the contractor for his use in area where surface excavation has already been completed except the additional excavation which the contractor may be directed by the engineer to carry out, will be measured and paid for at the same unit rate entered in the BOQ as for the original excavation.

(xviii) Change in methodology.

(xix) No payment shall be made for the material excavated from project sites used for backfill.

CHAPTER-6

UNDERGROUND EXCAVATION

INDEX

6.1 Scope of Work

(i) The specifications described herein under relate to the excavation work for the underground structures and shall include all labour, materials, equipment, all drilling and blasting, loading, transporting and disposal of materials in spoil or stockpile areas as well as the removal of all loose material and cleaning of excavated surfaces, to be carried out by the contractor under this contract. The work shall be done by conventional method of drill and blast or by mechanical means such as road header / twin cutter or by combination of these. It is up to the contractor to choose the method of excavation so as to complete the works within the time schedule prescribed elsewhere in these documents.

(ii) Excavation shall be made to the lines, grades and dimensions shown on the drawings or as otherwise directed by the Engineer.

(iii) The contractor shall comply with all safety procedures and requirements as stipulated in the Chapter-Safety Precautions.

(iv) Rock supports, shotcrete and dewatering works are covered in other chapters of these Specifications.

(v) The contractor shall be required to perform exploratory drilling during excavation of the tunnel.

(vi) The approval given by the Engineer, to the contractor's methods and equipment, shall not relieve the contractor of his full responsibility for a proper and safe execution of underground excavations, or of liability for injuries to, or death of persons, or any obligations under this contract.

6.2 Submittals

(i) At least 45 days prior to the commencement of excavation, the contractor shall submit details of his excavation methods and sequences for all underground works and portal excavation including equipment, ventilation, air cooling equipment, rock support, details of methods for drilling probe holes and safety measures.

(ii) The description of drilling and blasting procedures shall include the following:

(a) Diameter, spacing, depth, pattern and orientation of blast holes.

(b) Type, strength, amount, column load and distribution of explosives to be used per hole, per delay and per blast.

(c) Type of detonators, powder factor and sequence and pattern of delays to be used per blast.

(d) Description and purpose of any special method to be adopted by the contractor.

(e) Sequence of various activities of the excavation work in different headings with an indication of corresponding time requirements for each of the stipulated excavation classes.

(iii) At least 30 days prior to dumping or stockpiling of any material, the contractor shall submit the layout of the spoil and stockpile areas, which shall be within the area assigned on the bid drawings or as approved by the Engineer. All pertinent data of working methods and provisions for the security, stability, and temporary and permanent drainage of the areas shall be included, and details of volumes, material types, heights and grades provided.

(iv) To enable the Engineer to verify all necessary setting out and elevations carried out by the contractor, the latter shall notify the Engineer in writing, giving at least 7 days notice, of his intention to start excavation.

(v) During the advance of underground excavation, the contractor shall record and submit weekly to the Engineer 3 copies of the following:

(a) General items, regardless of the method of excavation:

- Theoretical volume of solid material excavated according to typical sections shown on the construction drawings.
- Amount, location, spacing, and type of steel ribs/lattice girder and lagging installed in the various zones, as defined hereafter.
- Surface of shotcrete, and wiremesh, installed in the various zones
- Number, length, and types of rockbolts, installed in the various zones.
- Geology, competence of the rock formations, rock falls, zones of instability, and information obtained from probe holes.
- Graphical representation of the locations, lengths and orientation of the probe holes.
- Occurrence of gas, if any
- Water inflows at the heading face, and the rate of discharge of water from the dewatering system and temperature of the water.
- Personnel employed during various stages of the operation and their qualification
- Time required and details for each activity
- Unusual occurrences, all delays and the reasons for delays
- Volume of fresh air in the heading zone/machine and backup equipment zones.

b) Special items referring to Conventional Excavation:

- Advance of each heading face and the chainage of heading face before the blasting of each round.

- Type and number of drill holes, and length of each round.
- Pattern of drill holes, their diameters and length.
- Type, quality and location of explosives in each drill hole, and blasting scheme (direct or retarded)
- For overbreaks and cavity formation contractor shall be responsible for taking video/still photographs of overbeaks in the presence of Engineer and providing copies to the Employer. The exact locations and/or chainage shall also be included there in.

(vi) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

6.3 Standards

i) The work shall be carried out as per following Indian standards or, where not covered by these standards or, where not covered by these standards, to their equivalent international standards (latest edition)

IS: 5878	Code of Practice for construction of tunnels conveying water
IS:10386	Safety Code of Construction, operation & maintenance of river valley project (Part-11) Underground Excavation.
IS: 3764	Safety Code for excavation works

ii) in case of conflict between the above standards and their specifications given herein, the specifications shall take precedence.

6.4 Definitions

6.4.1 Conventional Excavation

Excavation performed by conventional tunneling using drilling and blasting or by manual means.

6.4.2 Mechanical Excavation by Road header/twin cutter

Excavation performed by mechanical means such as Road header/twin cutter etc.

6.4.3 Multi-drift/Multi-segmental Excavation

Multi-drift/Multi-segmental excavation is defined as the excavation of tunnel heading in segments. Various segments will be excavated one by one and supported involving segmental ribbing ultimately to form complete rib. Certain portion of excavation may not require drilling and blasting and at certain locations restricted blasting may be required.

6.4.4 Heading Face

The advance end or wall of a tunnel, shaft or other excavation at which the work is progressing.

6.4.5 Heading Zone

Heading zone refers to tunnels (Upstream and Downstream headings) and shafts (vertical or inclined) with upward and downward heading excavated by conventional method (drilling and blasting) and is defined as the zone between the newly established face and the distance equal to 1m plus the length of the previous round behind that face, measured along the tunnel or shaft centerline.

6.4.6 Rear Zone

Rear zone is the whole length of tunnel between the heading zone and the Portal.

6.4.7 Excavation Progress Rate per Working Day

The daily excavation rate is the average of daily rates in length calculated over a period of 1(one) month.

6.4.8 Working Day (WD)

Working days are calendar days on which work is performed. When working days are mentioned in writing, they have to be indicated with additional indices such as WD1, WD2 or WD3 in order to show whether on the day in question 1, 2 or 3 shifts will be working.

6.4.9 Crown

Crown is the top arch of the tunnel upto and springing line.

6.4.10 Springing Line

(i) D-Shape Tunnel: The level at which crown and vertical walls of the tunnel meet is called springing line.

(ii) Circular Tunnel: Horizontal line passing through the center of the tunnel is called springing line.

(iii) Horse shoe / Modified Horse shoe Tunnel: Horizontal line passing through the center of the tunnel is called springing line.

6.4.11 Portal

Portal is an opening on the exposed surface open *to sky* which provides a well-defined access to the tunnel. This protects the tunnel face from loose overburden falling above the tunnel opening.

6.4.12 Round

Round is defined as a single cycle of drilling, loading and blasting to excavate rock, scaling, mucking and moving construction equipment in and out etc.

6.5 Excavation Lines and Tolerances

(i) Typical cross sections, excavation lines, and dimensions of excavations and thickness of lining, where appropriate are shown on the drawings.

(ii) The A-Line (Minimum Excavation Line), as shown on the drawings, is the line within which no rock material shall be permitted to remain.

(iii) The B-line (Pay Line) as shown on the drawings, is the line beyond and parallel to A-Line (minimum excavation line), at which the payment for excavation will be made, even if the actual excavation is between the minimum excavation line and the pay line. Unless specifically mentioned otherwise, the pay line for underground excavations (tunnels, shafts, Chambers & multijunctions etc.) shall be taken as 100 mm beyond the minimum excavation line for all classes of rock including extremely poor rock.

(iv) The contractor shall take into account the grade and alignment in exactness of the excavation by his excavating equipment and shall guarantee that the theoretical thickness of the concrete lining is never reduced. All out-of-line excavation shall be rectified so that the minimum excavation line as defined above is maintained.

(v) With regard to the internal diameter of the finished lining, the thickness of the lining shall not be reduced.

(vi) Immediately behind heading face, the contractor shall measure the excavated profile by means of a laser profiler or any other better method approved by the Engineer.

(vii) The contractor is required to perform the excavation works in such a way that the final excavation surface is located between the pay line and the minimum excavation line.

(viii) Excavation not shown on the drawings but which the contractor considers necessary for his own purposes, such as excavation for train switches or stations, rail foundations, mucking pits, pump sumps, ditches other than those shown on the drawings, spaces for supply facilities, fabrication of structures etc., may only be carried out with the prior approval of the Engineer. All such excavations shall be backfilled with concrete of minimum M-10 grade upto the minimum excavation line prior to the commencement of the final tunnel lining or alongwith final concrete lining. However, payment for excavation and concreting shall be restricted upto payline only.

(ix) Excavation of adits, other than those shown on the drawings or increase in the size of the adits, by the contractor for his own convenience shall be subject to the prior approval of the Engineer and at contractor's cost. Such adits, when no longer required, shall also be plugged, as directed by the Engineer at the cost of the contractor.

(x) The location of the tunnel portals shown on the construction drawings is only approximate/indicative. The actual position will depend on the ground conditions and will be determined by the Engineer during the progress of the work.

6.6 Approved Overbreak.

(i) Excavation beyond the pay line is defined as overbreak. The overbreak may be :

(a) Unapproved overbeak.

(b) Approved overbreak.

(ii) Approved overbreak:-. 'Approved overbreak' consists of that portion of overbreak outside the B-line, the occurrence of which is an unavoidable result of adverse geological conditions beyond control of contractor and not due to negligence or lack of reasonable care and skill in excavation operations while each of the following conditions are simultaneously fulfilled:

(a) Overbreak extends beyond the B-line measured from the deepest point of the overbreak. At locations where measurement of overbreak is not measurable for working out the volume, overbreak shall be measured by way of number of muck cars/dumpers removed. Capacity of muck cars/dumper be taken after giving due allowance to applicable voids.

(b) The overbreak occurs above the invert of the tunnel or other underground structures.

(c) The Engineer is immediately informed and given an opportunity for inspection while both the cause and the extent of the overbreak are identifiable.

(d) Overbreak was, in the opinion of the engineer, not result of contractor using improper or improperly applied working methods or his otherwise negligence, and could not have been prevented by prompt and appropriate installation of supports.

(iii) In case the over break is approved by the Engineer the same shall be considered from B- Line.

(iv) If, for any reason other than accepted geological reasons, excavation is carried out beyond the B- line, the contractor shall at his own cost remove the excess material including carriage/haulage and dumping upto dumping areas which could be assigned by the Engineer during construction and back fill the voids with minimum M 10 concrete, as described above without any measurement thereof.

(v) The contractor shall survey and plot cross sections at sufficient intervals, to be approved by Engineer, to allow for a reasonably accurate estimate of the volume of overbreak, which he claims to be due to geological conditions.

6.7 Additional Excavation

(i) The contractor may be directed by the Engineer to enlarge or change the section or carry out excavation beyond the minimum excavation line in parts of the Underground works where excavation has already been completed. Such excavation shall be defined as additional excavation.

(ii) Additional excavation may be carried out for, but not be limited to, the following purposes:

(a) To enlarge the excavated cross section in the rear zones to enable the insertion of new or additional steel ribs for support.

(b) To enable the Engineer to carry out rock mechanics tests associated with the determination of rock properties.

(c) To enlarge the tunnel cross section in the rear zones to accommodate the increased thickness of the concrete lining for structural reasons.

(iv) The contractor shall make the necessary provisions in his planned excavation activities to enable such additional excavation to be carried out concurrently with the main excavation without disruption or delay.

6.8 Supports for Underground Excavation

(i) The supports for the underground excavation shall generally consist of shotcrete as primary element, supplemented as needed by individual or pattern rock bolts, possibly with wire mesh/SFRS, Structural steel supports/lattice girder as required by the rock class as determined by the Engineer.

(ii) The contractor shall install the support system as shown on the drawings or as directed by the Engineer in any part of the underground excavation on the basis of rock class encountered or predicted during the Work. The decision of the Engineer shall be final in this regard.

(iii) The contractor shall employ a supervising Engineer, who by their schooling, knowledge and experience in supporting Work, qualifies to act as Support Supervisor(s). The support supervisor(s) shall examine the rock conditions after each excavation advance and shall verify that the rock support system is installed as directed. The support supervisor (s) shall be able to order installation of additional supports or to stop further advance if, in his opinion, the conditions are unsafe with approval of Engineer. However, he shall have no right to cancel type or amount of rock supports previously directed by the Engineer. The support supervisor(s) shall be present at each heading face throughout the duration of underground excavation Work.

(iv) The required supports shall be installed within cycle time without delay during the process of excavation within the heading zones. In the rear zones additional supports shall be installed immediately after it is observed that the supporting system previously installed is not sufficient to prevent further loosening of the material surrounding the excavation with the approval of Engineer.

(v) No further excavation should be permitted without complete installation of support system as directed by the Engineer.

(vi) Shotcrete, with or without steel wire mesh shall be applied to excavated surfaces, in accordance with the provisions of Chapter-Shotcrete. The contractor shall take into account, in his construction planning, that placing of

shotcrete protection will be required immediately after blasting a round in conventional method of drill and blast**,** but before mucking is started.

(vii) Structural steel supports/lattice girder, rock bolts and wire mesh shall be installed in accordance with the provisions of Chapters-Structural Steel Supports, Rockbolts and Wiremesh.

(viii) Fore poling may also be required while using steel ribs and essentially with lattice.

(ix) The use of timber will not be permitted for tunnel supports in any form, not even for temporary purpose.

(x) The contractor shall keep on the site, all necessary Construction Equipment for installing rockbolts and shotcrete, ready for operation in the excavation heading zones during the entire excavation period.

(xi) Even though it is the Engineer who determines the type and amount of rock supports to be installed, it is the contractor who shall bear the whole responsibility for the proper and safe excavation including the provision of extra supports and special protection for the personnel when the conditions so require.

6.9 Classification of Underground Excavation

6.9.1 General

(i) The entire underground excavation has been divided into two categories on the basis of Q values. Excavation in rock class with Q value more than 0.1 has been placed in one category (here-in-after referred to as excavation in all classes of rock). Excavation in rock class with Q value less than 0.1 has been placed in 2nd category (here-in-after referred to extremely poor rock class). Also, occurrence of any kind of tunneling condition including aeolian deposits, volcanic ashes, soil deposits, river bed material etc. shall also be included under this class only. The same excavation classes are also applicable for excavation by mechanical means.

(ii) No excavation class shall be differentiated for the excavation of the caverns and shafts.

(iii) Q value shall be determined based on “Barton system” by the Engineer after each blast which shall be binding on the contractor.

(iv) The assessment of an individual excavation class shall always apply to the whole of the theoretical excavation cross section as defined by the minimum excavation line, irrespective of the excavation methods (e.g. heading and benching and/or full face) used.

6.9.2 Support System:

The support system required for different rock masses shall be as under:

(a) Class-I (Very Good) - 'Q' greater than 40 and upto 100.

The excavated section shall be basically unsupported. Spot rock bolting and shotcreting in localized areas may be required.

(b) Class-II (Good) - 'Q' greater than 10 upto 40.

The excavated section shall be basically unsupported. Spot rock bolting/ pattern rock bolts and shotcreting in localized areas may be required.

(c) Class-III (Fair) - 'Q' greater than 4 upto 10.

The support system shall consist of pattern rock bolts and shotcrete in one or more layers with welded wiremesh/SFRS in the crown upto springing level or as specified in the drawings.

(d) Class-IV (Poor) - 'Q' greater than 1 upto 4.

The support system shall consist of pattern rock bolts and shotcrete in one or more layers with welded wiremesh/SFRS in the crown and walls or as specified in the drawings. Alternatively, the support system shall consist of lattice girder/steel ribs without invert bracing, which may be complemented with rock bolts and plain shotcrete/lagging backfilled with concrete as provided in construction drawings.

(e) Class-V (Very Poor) - 'Q' greater than 0.1 upto 1.

The support system shall consist of pattern rock bolts and shotcrete in one or more layers with welded wiremesh/SFRS in the crown and walls or as specified in the drawings. Steel ribs with invert strut and lagging placed continuously at the heading face and backfilled with concrete immediately after excavating the whole or a part of the cross section. Forepoling may also be required. Lattice girder with forepoling may be provided in place of steel ribs, where ever required.

(f) Extremely Poor Rock Class 'Q' less than and upto 0.1

The support system shall consist of forepoling, rock bolting and shotcrete in one or more layers with welded wiremesh/SFRS in the crown and walls or as specified in the drawings. Simultaneously steel ribs shall be provided and backfilled with concrete immediately after excavating the crown of the tunnel. Walls shall be supported with ribs and invert strut provided in the invert.

(g) No classes will be attributed within the portion where multi-drift/multi-segmental excavation has been performed.

6.10 Probe Hole

(i) A probe hole, wherever required, shall be drilled by percussion drilling ahead of the tunnel excavation to determine, in advance, the nature of the material to be excavated and the presence of water and gases. These probe holes are separate from the exploratory holes ordered by the Engineer as stipulated in Chapter - Drilling and Grouting.

(ii) The drilling of the probe holes shall be included in a normal pattern of drilling the blast holes. The length of the probe holes shall be atleast the length of the expected day's excavation advance. The length of the probe hole shall be as determined by the Engineer.

(iii) Based on the probe holes information, the contractor shall, without delay, provide to the Engineer, in writing, his assessment of the expected material to be encountered.

(iv) Should the probe hole indicate the presence of excessive water, poor rock conditions ahead of the excavation face, the contractor shall take appropriate precautions such as pre-grouting, draining, or adopting such suitable measures as necessary to facilitate excavation. Similarly, the contractor shall adopt suitable measures to deal with any gases or zones or weakened rock which may be encountered. All measures deemed necessary by the contractor shall be subject to approval by the Engineer.

6.11 Pre-grouting

(i) Poor ground condition in underground excavation may require, ahead of face stabilization/ support using pre-grouting.

(ii) Pre-grouting shall consist of drilling of 38mm dia. holes (up to 10 m long) at an inclination of 5 to 10 degrees outgoing along the periphery at an approximate spacing of 1.5 m. These holes shall be grouted using a neat cement grout mix with w/c ratio varying from 0.8 to 0.4; bentonite shall be added as necessary and as directed by the Engineer.

6.12 Execution

6.12.1 General

(i) Prior to the commencement of underground excavation for tunnels, the contractor shall construct a portal as per drawings or as directed by the Engineer in order to provide a good abutment for the forces created in the rock due to the first opening.

(ii) All rock material projecting inside the minimum excavation line shall be removed.

(iii) All loose rock shall be removed from the underground construction Sites and disposed off in the assigned dump areas.

(iv) The contractor shall constantly check the progress of excavation by means of Laser survey in order to avoid any substantial rectification of the already opened profile and eventual rearranging of the installed rock supports.

(v) Where excessive inflows of water occur at the heading face, the contractor shall take all appropriate measures to execute the excavation work safely and properly, including provision of extra supports with the approval of Engineer and protection of workmen, and any special equipment necessary for working in waterlogged conditions.

(vi) When deemed necessary and ordered by the Engineer, the contractor shall carry out long exploratory drilling with or without core recovery as described in Chapter-Drilling and Grouting.

(vii) The Geo-technical Report, being a part of Contract Document, contains the results of Geo-technical/Geophysical studies carried out on the project. The contractor shall be expected to have made himself fully conversant with the geological conditions likely to be encountered in the underground works and shall keep himself in a state of preparedness for these. The contractor may make his own assessment about the geological conditions prevalent in the Project area, however, Contractor shall be responsible for his own assessment including the liability emanating therefrom and Employer does not take any guarantee of the interpretations made by the Contractor.

(viii) The orientation of the tunnel, shaft, pressure shaft or caverns as indicated on the Bid drawings is tentative and subject to modification upon availability of further information with regard to orientation of schistosity, main discontinuities and on the direction of principal ground stresses. It may be necessary to introduce slight shifting of the axis of the tunnel, shaft, pressure shaft or caverns after additional information from exploratory drifts and in-situ tests is available. The construction drawings showing the final orientation will be issued to the contractor prior to start of work and he shall be required to execute the work as per Drawings or as directed by the Engineer.

(ix) Sheared or shattered rock zones, foliation shears, thick joints with gouge or other thick discontinuities may be encountered during excavation. Wherever shear zones and poor rock bands are encountered along the tunnel or caverns, adequate methods of rock supports e.g. forepoling, shotcrete combined with rock bolting and steel rib/lattice girder may be adopted at once by the contractor to contain overbreak formation, as shown on the construction Drawings or as directed by the Engineer.

(x) The contractor shall obtain the approval of the Engineer for his proposal to adopt sequence of construction according to his method of excavation.

(xi) Medium to heavy inflow of ground water conditions may be encountered. Also geothermal conditions at tunnel grade coupled with high rock temperature and hot water may be encountered during excavation. Keeping in view the high temperature and heavy inflow of water, the contractor shall provide adequate ventilation/ cooling measures/drainage arrangements in order to bring down the ambient air temperature inside the tunnel and to

manage inflow of ground water. The payments for such activities shall be made as per the rates provided in the Bill of Quantities.

6.12.2 Method of Excavation

The excavation of the tunnel is proposed to be carried out by conventional method of drill and blast or by mechanical excavation method or multi-drift/multi-segmental method or DRESS (Drainage reinforcement excavation and support solution) or a combination of these methods. The contractor may propose his sequence of excavation to achieve the desired profile giving full details of the design of the support system etc. This sequence shall be subject to the approval of the Engineer.

6.12.3 Conventional Excavation (Drilling and Blasting)

(i) The contractor shall establish by trial blast and use drilling and blasting techniques which will produce a smooth final profile, a minimum of overbreak and a minimum of fracturing of the rock beyond the required excavation lines. The techniques used shall be, at all times, subject to the Engineer's approval, who may direct several blasting tests to be undertaken by the contractor to substantiate his proposed methods of blasting.

(ii) All conventional excavation shall be performed by controlled blasting techniques as described below:

(a) Presplitting

It consists of drilling a single row of closely spaced holes along the final excavation perimeter. These holes are lightly charged and simultaneously detonated before the main blast, to produce a presplit crack which limits the propagation of cracks from the subsequent main blast, and in such a way reduces damage in the rock beyond it. The blasting of the main excavation zone requires a reduced explosive charge in the line of holes nearest to the presplit line, and a limit on the distance between the presplit line and the nearest line of main blast holes. The presplit holes shall be drilled deeper than the depth of the round.

(b) Smooth Blasting

It consists of drilling a number of closely spaced holes along the final excavation perimeter, placing light charges in the holes and detonating the charges simultaneously after the main blast. The outer line of drill holes for the main blast is set at an approved distance inside the final perimeter leaving an annulus of rock to be peeled off the damaged final excavation perimeter by the smooth blast. The smooth blast holes are drilled, charged and blasted in the same tunneling cycle as the main blast.

(c) Cushion Blasting

A special case of blasting in which considerable air space or stemming surrounds charges in the holes and serves to reduce undesired blast effect on the final excavation perimeter.

(iii) During the progress of excavation, the drilling and blasting pattern, specifically the number and depth of holes, quantity, quality and distribution of explosives, shall be varied as necessary to suit the rock conditions encountered, taking into consideration the information obtained from the probe holes, the actual drilling work (velocity, colour of rinsing water, etc.) as well as the previous blasting results.

(iv) Only wet drilling will be permitted in order to reduce dust in the underground excavation.

(v) Perimeter drill holes shall be placed such that the over excavation beyond the minimum excavation line is minimized. The spacing of holes shall not exceed 50 cm. The contractor shall pay utmost attention to obtain a smooth and uniform excavated surface.

(vi) Should the entire length of most of the perimeter drill holes not be visible after each round of blasting, the contractor shall make an adequate adaptation in the blasting pattern used and submit it to the Engineer for approval.

(vii) The depth of a new round shall never exceed that which was determined and approved prior to commencement of blasting. The Engineer may order a reduction of the adopted round depth if the actual rock condition requires it.

(viii) Blasting of a new round will not be permitted if no, or insufficient, personnel are available to perform the mucking and subsequent support work afterwards. In particular, this applies to work before holidays, non-working weekends etc.

(ix) Blasting that may damage the rock beyond the required excavation lines or the tunnel installations will not be permitted. Any damage to, or displacement of the supports, and any damage to, any part of the works caused by blasting or any of the contractor's operations shall be repaired by the contractor in a manner satisfactory to the Engineer**,** at no cost to Employer.

(x) No new round shall be blasted until the supports required within or behind the heading zone have been installed.

(xi) All loosened material that is likely to fall shall be removed immediately following blasting, at frequent intervals during the progress of the work, and finally during the clean-up prior to placing the final tunnel lining.

(xii) After excavating, the contractor shall adequately protect the tunnel invert surface from damage caused by the construction traffic at his own cost. Should small grain or broken excavation material, or any other material considered fit be used for such protection, it shall be removed prior to placing the final tunnel lining. No vehicular traffic will be permitted over tunnel invert after removal of the protective material.

(xiii) In case, further advance is not possible with the normal method of excavation or with the equipment employed by the contractor, in heading and benching in

all classes of rock, the contractor may have to adopt special measures/specialized methodology and equipment, as approved by Engineer, which may include but not be limited to multiple drift method of excavation, mechanical means of Road header/twin cutter, DRESS methodology or any other method of excavation.

6.12.4 Blasting Personnel

(i) The contractor shall engage a full time professional blasting expert to assist in establishing satisfactory blasting techniques subject to the approval of Engineer, at no additional cost to the Employer.

(ii) The contractor shall provide licensed Blaster and inspectors capable of inspecting freshly blasted faces, deal with misfires, evaluate air and dust conditions and direct scaling operations in accordance with the safety requirements as envisaged in “Safety Precautions”. All blasting operations including handling of explosives shall be done by the licensed blasters only.

6.12.5 Line drilling

(a) Line drilling shall be used where control perimeter blasting may cause excessive damage to the surrounding rock or where there are structures adjacent to the excavation as mentioned in drawings or as directed by the Engineer.

(b) Line-drilling is drilling of closed spaced holes along the neat excavation line. These will form a surface of weakness to which the primary blast can break. Light blasting with well-distributed charges fired after the main excavation is removed may be permitted in the holes. If, however, in the opinion of the Engineer the blasting may injure the rock, the–use of explosives shall be discontinued and the excavation shall be completed by broaching, wedging, or barring.

6.12.6 Cleaning of Excavated Surfaces

(i) Even prior to the removal of the bulk of the material loosened by blasting, the contractor shall clean the newly exposed rock surface from rock fragments, dust and debris to permit, if required, the application of the first layer of shotcrete. Windows in such layer shall be left open for the geological mapping and inspection.

(ii) Cleaning shall be done by directing a jet of water or air at the rock face. Compact, washable rock shall be cleaned with compressed air-water jets. Rock which is prone to quick disintegration, swelling, heaving, or is interspersed with clay filled fissures shall be cleaned with compressed air only. The cleaning shall be done to the satisfaction of the Engineer.

(iii) The cleaning is separate from the clean-up of excavated surfaces required immediately prior to placing of the final tunnel lining described in Chapter - Cement Concrete".

6.12.7 Excavation of Caverns/Chambers

Initially a central heading along the longer axis shall be excavated and supported with the primary supports as envisaged in the construction drawings. The either side of the heading shall be excavated by slashing and shall be supported simultaneously as shown on the drawings. The contractor shall furnish the excavation sequence proposed to be carried out by him for the approval of Engineer. The excavation sequence shall clearly indicate the line, levels and sequence numbers of the excavation methodology proposed to be followed.

It should be specifically understood that the contractor shall be allowed to carry out benching only when the entire primary rock support as envisaged in the construction drawings has been fully placed in entire width of the chambers and accepted by the Engineer.

6.12.8 Excavation of Shafts

(i) The Surge shaft, the Pressure shaft, shafts for Draft tube gates shall be in general excavated by full sinking method.

(ii) In case the contractor prefers to excavate any of the shaft by first driving a Pilot shaft followed by slashing, then the cost of the rock support and ground treatment during the course of pilot excavation shall be borne by the contractor.

6.12.9 Provision of Niche

Contractor may be allowed to excavate niches at suitable locations approved by Engineer for contractor's construction facilities and/or turning of vehicle. The size of the niche shall be as approved by the Engineer. For this purpose, contractor will submit his proposal for prior approval of Engineer in writing. After having served its purpose, it shall be backfilled with suitable material with prior approval of the Engineer.

a) Disposal of Excavated Materials

(i) All materials from underground excavation suitable for use as fill, concrete aggregates or for other purposes shall be stockpiled on the site as directed or approved by the Engineer, if the immediate placement in the final location in permanent works is not possible.

(ii) Excavated materials, which are not suitable for or are in excess of the permanent construction requirements, shall be disposed off in the waste disposal areas shown on the drawings, or in areas assigned as such by the Engineer in the course of the work.

(iii) The contractor shall shape and trim the dumping areas and stockpiles to the lines and grades as directed or approved by the Engineer, and shall provide for adequate diversion of existing water courses. The area over which the excavated material is to be disposed shall be stripped of all vegetations. If the area is steeply dipping, precautions shall be taken to ensure stability of the material in the area, including base drainage and surface protection against erosion. The material dumped shall be compacted, by movement of the dumping vehicles, and grading as necessary, in layers not exceeding 1.0 m in depth. It shall be the responsibility of the contractor to remove any material from any slide that may occur in the disposal dump or its base and re-dispose the removed material properly to the satisfaction of the Engineer. Prior to the commencement of excavation work, the contractor shall have prepared the disposal area including providing of retaining/breast walls and gabions to the satisfaction of the Engineer and the methods proposed for disposal shall also have received approval of the Engineer. Employer shall bear the cost of retaining/breast walls and gabions in protection works.

(iv) The contractor shall be liable for any damage to temporary or permanent works or to the property of third parties caused by poor drainage in the waste disposal or stockpile areas.

(v) If additional areas are required for disposal of the excavated materials, the contractor shall propose such areas for approval of the Engineer.

(vi) The contractor shall ensure that no excavated materials are disposed off in the streams or at locations, where in the opinion of the Engineer, these are liable to be washed away by the floods.

(vii) Excavated materials shall be transported to the disposal areas in such a way that spillage onto roads etc. is avoided. Any materials which, despite the contractor taking reasonable care, does fall onto roads etc. shall be promptly cleared and removed by the contractor.

6.14 Evacuation of Water

The contractor shall carry out all works required to capture and drain service and infiltrated groundwater during the construction as stipulated in Chapter Dewatering, Drainage and Pumping.

6.15 Illumination

The contractor shall install an adequate illumination system in the Underground Works as stipulated in Chapter - Site Installations and Services.

6.16 Ventilation and Air Cooling

The contractor shall install and operate equipment and carry out all works required for the ventilation and air cooling as stipulated in Chapter - Site Installations and Services.

6.17 Control of Dust, Silica and Noxious Gases in Underground Works

The contractor shall install and operate equipment for the control of dust, silica and noxious gases in Underground works as stipulated in Chapter - Site Installations and Services.

6.18 Communication System

The contractor shall install and operate the communication system between each heading face and entrance to the tunnel as stipulated in Chapter - Site Installations and Services.

6.19 Geological Mapping

(i) Concurrently with excavation, the Engineer's representative will map the geological conditions along all tunnel(s)/shafts/caverns. The contractor will assist Engineer's representative in mapping by engaging qualified geologist(s).

(ii) This mapping and related information, alongwith the rock mechanics test results, will be used in design of the final lining for the tunnel(s).

(iii) The contractor shall provide adequate lighting, ventilation and reasonable access for mapping. Cleaning and washing of the walls and crowns may be necessary for mapping.

6.20 Measurements and Payments

6.20.1 General

(i) Measurement for payment for underground excavation in any rock class will be made as per the relevant items of BOQ.

(ii) The definitions of the rock mass classes are only relevant for deciding the rock supports. The rock supports will be measured for payment and paid for separately.

(iii) For multi-drift/multi-segmental method of excavation irrespective of the class of rock, payment shall be made at the unit rates entered in the BOQ for relevant item. The estimated quantities for excavation given in the Bill of

Quantity are not to be considered as an accurate indication of the quantity of work since the predicted and the actual length of each excavation class may differ due to geotechnical conditions encountered in the course of work. If the extent of percentage of individual rock class differs at the time of actual execution in comparison to predicted rock class in Geotechnical Report, no rate revision will be allowed on this ground except due to provisions made in variation clause.

(iv) The Unit Rates, if not specifically stipulated otherwise, shall be deemed to include the entire cost of, but not be limited to, the following:

a) Provision of all labour, equipment and materials required for the underground excavation including drilling for holes for blasting, developing and improving controlled blasting methods, blasting test and performance of blasting cleaning, washing, protection and maintaining excavated surfaces in satisfactory conditions, and protection of tunnel invert until the concrete lining is placed all enlargements and additional excavations required by the contractor for his construction methods; all temporary supports.

b) Provisions for and operation of the traffic, loading, hauling and dumping the excavated material on stockpiles or points of incorporation into Permanent Works upto 1 km from portal; shaping and trimming of the excavated materials in the stock pile area, which contractor shall have prepared including providing of retaining/breast walls and gabions, clearing of the stockpile areas, formation and maintenance of stock piles, re-handling of suitable materials including segregating, grading, draining and drying of materials suitable for use in embankment construction or as backfill.

c) Provisions for and operation of the traffic, loading, hauling upto 1 km from portal, dumping, shaping and trimming the excavated material in dumping areas, as specified.

d) All delays during excavation work resulting from installation of additional rock supports required by the geological conditions of the material encountered, irrespective of distance from the face.

e) Complying with all requirements of statutory laws and regulations relating to underground works and any restrictions resulting therefrom; obtaining all necessary permits and licenses for the purchase, use, storage and transport of explosives and other material.

f) Surveying, setting out, checking of excavated profile and alignment, and any subsequent rectification works resulting from undue or incorrect surveys; provisions of suitable equipment for, and delays due to carrying out this work.

g) Furnishing, installation, operation, maintenance, and removal of communication, illumination, and ventilating systems; observing safety precautions and measurement of dust and silica.

h) Furnishing, installation, operation, maintenance, and removal of communication, illumination, and ventilating systems; observing safety precautions and measurement of noxious gases. However, separate payment for excavation shall be made at the unit rates entered in the BOQ for relevant item in case the concentration of noxious gases exceeds the limits specified under chapter-2.

i) Recording and preparation of reports related to excavation progress and procedures.

j) All works involved with and any partial or short interruptions or inconveniences caused by the check surveys, performance of the rock mechanics tests, installations and monitoring of instruments and geological mapping, for which no separate payment is provided elsewhere in these specifications.

k) Seepage water suitably collected and drained away by gravity.

l) Change in methodology of excavation for Contractor's convenience.

m) Utilizing the services of full time professional blasting consultant.

(v) Extra payment will be made for hauling the excavated material (upto payline and from approved overbreak) beyond 1km from the Portal. Measurement for payment will be based on the in-situ volume (upto payline and from approved overbreak) multiplied by the actual distance in excess of 1 km from portal. Payment for such volume will be made at the Unit Rate entered in the Bill of Quantities.

(vi) Where due to Geological reasons, excavation had to be performed by multi-drift/multi-segmental method of excavation, measurement for payment will be of the in-situ volume obtained by multiplying the theoretical cross-sectional area defined by the B-line, by the effective length as approved by the Engineer. Payment will be made at the Unit rate as entered in the BOQ.

6.20.2 Conventional Excavation of Tunnels, shafts and caverns

(i) Measurement for payment for underground excavation will be of the in-situ volume defined up to the pay line as specified in these specifications.

(ii) Payment will be made at the relevant Unit Rate entered in the Bill of Quantities, which shall also include the entire cost of:

a) Drilling the probe holes and holes for blasting.

b) Developing and improving controlled blasting methods.

c) Blasting tests, explosives and performance of blasting.

d) Excavation of pilot shafts or raise boring of vertical shafts, should the contractor choose such method of excavation.

e) Coping with all difficulties due to properties of the material encountered.

(iii) Volumes for payment for excavation will be obtained by multiplying the theoretical cross sectional area upto the pay line, by the length measured along the established center line of the tunnel.

6.20.3 Line drilling

(i) Measurement for payment for line drilling will be of the length of the holes actually drilled into the rock along the side of the excavation as directed by the Engineer.

(ii) Payment will be made at the unit price per meter of the drill hole irrespective of the diameter, entered in the Bill of Quantity, which shall include the entire cost of drilling the holes, light blasting, broaching, wedging, barring or other methods used in conjunction with line drilling.

6.20.4 Overbreak and Backfilling

(i) No payment will be made for the removal and haulage of material upto dumping area, assigned by the Engineer during execution of Contract, irrespective of distance involved, or for backfilling with concrete or shotcrete or grout, for excavation beyond the pay line except for approved overbreak as defined in these specifications.

(ii) Unapproved overbreaks shall be measured but not paid.

(iii) Measurement for payment for the removal of material and backfilling of voids arising due to overbreak will only be made if the overbreak is geologically accepted by the Engineer.

(iv) Payment for removal and haulage of material created by an approved overbreak will be made at the applicable Unit Rate entered in the Bill of Quantities.

(v) For payment for backfilling of voids created by an approved overbreak refer Chapter-Cement Concrete.

(vi) Voids outside of the payline which are not approved by the Engineer shall be backfilled with concrete or shotcrete at contractor's cost.

6.20.5 Additional Excavation

(i) Measurement for payment for additional volumes of excavation directed by the Engineer, will be of the in-situ volume regardless of material to be excavated i.e., no excavation classes shall be assigned.

(ii) Payment will be made at the Unit Rate per m^3 entered in the Bill of Quantities for additional excavation required by the Engineer.

(iii) In stretches where the performance of additional excavation requires removal and reinstallation of previously installed steel ribs and lagging, the payment for such work will be made at the rates analyzed and approved by the Engineer in terms of provisions of contract.

6.20.6 Exclusions

(i) All costs for dewatering of underground sites and overcoming difficulties due to the ingress of water shall be covered by the applicable Unit Rates as specified in Chapter - Dewatering, Drainage and Pumping.

(ii) All costs for exploratory drillings will be covered by the applicable Unit Rates as specified in the Chapter - Drilling and Grouting.

(iii) All costs for supply and installation of rock support will be covered by the applicable Unit Rates as specified in Chapter - Structural Steel Supports, Rockbolts and Wiremesh and Shotcrete respectively.

(iv) Rock supports installed by the contractor while not observing approved excavation methodology will not be included for payment.

(v) All costs for environment protection works shall be covered by the applicable Unit Rates as specified in Chapter – Environment Protection Measures.

6.20.7 No Payment will be made for the Following:

(i) Over-excavation/overbreak (excluding approved overbreak), removal of material including haulage and dumping upto assigned dumping area or backfilling with concrete, shotcrete beyond the pay line. This applies also to any rectification works resulting from incorrect surveys, incorrect blasting, wrong methodology adopted or any other reason attributable to contractor.

(ii) Additional Work of removing material and backfilling voids with approved material due to contractor’s poor working method or negligence.

(iii) Any excavation required by the contractor for his own convenience. The concrete and grout required to fill such excavation shall also be at the contractor’s expense.

(iv) Un-approved overbreak in additional excavation required by the Engineer.

(v) The report on probe holes.

(vi) Extra work or material required to repair damage to the tunnel invert caused by construction equipment.

(vii) Draining, shaping and trimming of the dumped material in waste disposal areas to the lines and grades as directed or approved by the Engineer except the cost of protection works like gabions, Retaining walls etc.

(viii) Excavation of adits including supports and backfill, other than those shown on the drawings, carried out by the contractor for his convenience and plugging thereof.

(ix) Rock supports required due to the contractor's not adhering to approved excavation methodology will not be included for payment.

(x) Clearing and grubbing in the spoil and stockpile areas.

(xi) Construction of drainage trenches proposed by the contractor in the tunnel inverts is included in the measurement for underground excavation.

(xii) Construction of Niches and their backfilling.

CHAPTER-7
STRUCTURAL STEEL SUPPORTS

INDEX

7.1 Scope of Work

(i) The specifications described herein under relate to the work which includes all labour, materials, equipment and services required for the supply, handling, fabrication and installation of structural steel supports consisting of steel ribs, lattice girders and lagging to be carried out by contractor in the underground excavation to the shape and dimensions as shown on the drawings.

(ii) Structural steel supports shall be installed either as complementary measure to the previously installed rock bolts and Shotcrete when those prove to be insufficient to stabilize the excavated profile, or as immediate supports after excavation in the heading zone when the material encountered in the process of excavation requires such measures.

(iii) Steel ribs and lattice girders shall be furnished complete with bracing, bolts, nuts, washers, plates, tie rods, and other accessories necessary for installation of the supports. Horizontal or bent steel bracing in the invert may be required.

(iv) Steel Lagging shall be provided separately from steel ribs.

(v) The contractor, if he considers necessary, may install temporary supports for his convenience and safety of his workmen/equipment during execution without any cost liability to Employer.

(vi) The supports shall be bent to the required shape by cold bending process only.

7.2 Submittals

(i) Within 30 days from the date of issue of Letter of Acceptance but before procuring or mobilization to the site, the equipment, the contractor shall submit to the Engineer the description, and drawings showing sufficient details of the layout, type and capacity of the equipment proposed for the fabrication of steel ribs/lattice girder.

(ii) At least 60 days in advance of the excavation of underground works being carried out on the site, the contractor shall submit to the Engineer the schedule for fabrication of steel ribs/lattice girder.

(iii) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

7.3 Standards

(i) The fabrication and installation of structural steel support shall conform to the following latest Indian Standards or, where not covered by these standards, to the equivalent International Standards:

IS: 5878 (Part-IV)	Code of practice for construction of tunnels conveying water
IS: 800	Code of Practice for general construction in steel
IS: 814	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
IS: 816	Code of Practice for use of metal arc welding for general construction in mild steel.
IS: 1786	Specification for High strength deformed steel bars and wire for concrete reinforcement
IS:2062	Structural steel (Standard Quality)
IS: 2502	Code of Practice for Bending and fixing of bars for concrete reinforcement.
IS: 2751	Code of Practice for welding of mild steel plain and deformed bars for reinforced concrete construction.

(ii) In case of conflict between the above standards or any other IS code and the specifications given herein, the specifications shall take precedence.

7.4 Necessity and Details of Structural Steel Supports

7.4.1 General

(i) Steel ribs/lattice girder shall be installed to support crown and walls of underground excavations in all areas where, in the opinion of Engineer, alternative methods of rock reinforcement shall not provide adequate support either for construction safety or for permanent stability.

(ii) The exact requirement for steel ribs/lattice girder in any area shall depend on actual rock conditions encountered as excavation progresses.

7.4.2 Steel Ribs

(i) The steel ribs shall comprise I-beam or built up sections as shown on the drawings.

(ii) Rib splices shall be welded or made of bolted plates in such a manner as not to reduce the section moment of resistance.

(iii) Only one section size of steel rib profile shall be used for each portion of the underground works and the structural requirements due to rock conditions

encountered shall be met by varying the spacing of the ribs as directed by the Engineer.

(iv) All steel section and plates used for ribs and accessories shall conform to IS :2062. "Structural Steel" (Standard Quality).

(v) Material used in splices shall conform to the specification of the material being spliced.

(vi) All steel and fabrication thereof shall conform to the requirements of IS: 800 "Code of Practice for use of structural steel in General Building Construction".

(vii) All welding, welding electrodes and workmanship shall conform to IS: 814 and IS: 816.

7.4.3 Steel Rib Accessories

Steel rib accessories shall include, but not be limited to, collar braces, spreaders, liner plates, cribbing, foot blocks and sills which are fabricated from steel plates or sections or other steel products. Steel support accessories shall be used with the steel ribs in the underground excavation and shall be used elsewhere when required by Engineer.

7.4.4 Pre cast RCC / Steel Lagging

(i) Lagging are the longitudinal supporting members placed between/behind the steel ribs where necessary to support the walls and crown of the underground excavation.

(ii) Steel lagging shall be made of the same material as steel ribs. The minimum thickness of the steel lagging shall be 3 mm.

(iii) Precast reinforced concrete panels of 10 cm thickness may be used as lagging instead of steel lagging. The type of lagging used must be approved by the Engineer before contractor start with the manufacture thereof. Concrete grade used shall be M15-A20 and reinforcement at the rate of 60 kg/m3 minimum shall be provided.

7.4.5 Lattice Girder

(i) Lattice girder shall comprise of curved arches fabricated from reinforcing bars. Girders spliced shall be fabricated from steel angles or steel plates as shown in the construction drawings issued by the Engineer.

(ii) Lattice girders shall be installed where shown on the drawings.

(iii) Lattice girders shall consist of 3 no., 25 mm or greater dia reinforcing bars forming an equilateral triangle (or square) of 150 mm or greater depth, laced together by 12 mm dia reinforcing bars. The lattice girders shall be installed in similar manner as steel ribs. The accessories of lattice girders, like plates, bolts, nuts washers welding electrodes etc shall be similar as indicated in 7.4.2. Lattice girders shall be fully encased in shotcrete.

7.5 Execution

7.5.1 Steel Ribs

(i) Steel ribs shall be bent with an allowance of one percent to the shape as shown on the drawings. Reshaping of the bent ribs at the place of installation may only be undertaken with Engineer's consent and only if the material properties would not be impaired.

(ii) Excavation of the underground works shall be completed true to the lines shown on the drawings before installation of steel ribs. The placement and spacing of the steel ribs shall be as shown in drawings or as determined by the Engineer.

(iii) Concrete blocks or steel profiles shall be provided as footings for the steel ribs. Use of timber as foot blocks shall be strictly prohibited. The foot plates shall be of sufficient size and rigidity. If required, the legs of the ribs shall be anchored to the rock by the rockbolts. Where invert bracing is required, it shall be fixed securely to the lower legs of the ribs in such a way that buckling is not induced in the steel rib by the presence of such bracing.

(iv) Steel sections and plates shall be cut, welded, bolted or otherwise proposed to the shapes and dimensions indicated on the drawings or as directed by the Engineer.

(v) Immediately after placing the ribs in a correct position, they shall be interconnected and braced by means of steel bars or beams in order to prevent any displacement and to maintain spacing. Use of timber spreaders shall be strictly prohibited.

(vi) The space remaining between the outer flange of the steel ribs and the rock surface shall be backfilled immediately after the rib has been placed over the entire circumference of the steel rib in order to provide uniform load distribution. In over excavation, the bulk of the voids space may be filled with concrete blocks, followed by shotcrete. If required, shotcrete shall be applied also between the steel ribs to form an arched bracing in the direction of the centerline of the underground excavation.

(vii) The contractor shall survey and record the position of all steel ribs installed in order to facilitate drilling operations. Their position shall be marked on the finished concrete lining surface.

(viii) Blocking and wedges used to set the steel ribs may be steel or concrete blocks.

(ix) Structural steel supports shall be maintained in position by the contractor after installation. Any steel rib installed improperly or damaged by the contractor's operations shall be adjusted, repaired or replaced as appropriate by the contractor without delay after notification by the Engineer.

(x) Lagging shall be placed behind the steel ribs where necessary to support the crown or the sides of underground excavations. Where conditions require, it may, supported on the last steel rib erected, be pushed by pressing and/or hammering into the ground ahead to provide a temporary overhead protection while installing the next steel rib (forepoling).

(xi) The space between the rock surface and the lagging shall be backfilled with concrete.

(xii) Backfilling between rock and lagging with rock spells, bracing with timber and timber lagging shall be strictly prohibited.

(xiii) During the course of work, the contractor shall maintain a sufficient reserve of steel ribs complete with accessories on each work site.

7.5.2 Lattice Girders

Fabrication and installation of lattice girders

(i) Lattice girders shall be fabricated with an allowance of one percent to the shape as shown on the drawings.

(ii) Excavation of the underground works shall be completed true to the lines shown on the minimum excavation line and at spacing as shown on the drawings or as determined by the Engineer. Where forepoling methods are used, the girders will need to be installed so as to follow the line of the forepoles so as to provide access for the installation of further sets of forepoles if required.

(iii) Lattice girders shall be securely fixed in position prior to shotcreting by a combination of rockbolts and steel or concrete packing between the girders and the excavated surface.

(iv) The contractor shall survey and record the position of all lattice girders installed in order to facilitate drilling operations. Their position shall be marked on the finished concrete lining.

7.6 Measurement and Payments

The Unit Rates entered in the Bill of Quantities shall be applied regardless of the excavation method used, i.e., conventional, full face or partial excavation (e.g. heading and benching, multiple drift, full face or any other specialized methods).

For the definitions of the various zones mentioned above, refer Chapter - Underground Excavation.

7.6.1 Steel Ribs

(i) Measurement for payment for supply, handling, fabrication and installation of the steel ribs will be of the weight of steel ribs actually installed and approved by the Engineer. Payment will be made at the Unit Rates per MT entered in the Bill of Quantities, which shall include the entire cost of:

a) Supply, handling, fabrication, transportation to the place of installation and installation of steel ribs, tie rods, joint plates, all foot plates, foot blocks, bolts, nuts.

b) Backfilling with concrete blocks except in geologically accepted overbreak which will be paid separately as set out in Chapter - Underground Excavation.

c) Surveying and marking the position of ribs on the finished concrete surfaces.

(ii) For the measurement and payment purposes, the weight of the steel ribs will be based on the unit weight of the steel profile per linear meter (without any accessories) as specified in the relevant IS codes.

(iii) Measurement for payment for props, invert struts and cross bracings/ bracings etc.(called as Miscellaneous Metal Pieces) shall be of the weight of metal pieces actually installed as approved by the Engineer. Payment will be made at the unit rate per MT entered in the BOQ which shall include supply, handling, fabrication, transportation to the place of installation and installation of metal piece.

7.6.2 Steel Lagging and Precast concrete lagging

(i) Measurement for payment for supply, handling, fabrication and installation of the steel lagging will be of the weight of lagging actually installed and approved by the Engineer. Payment will be made at the Unit Rates per MT, entered in the Bill of Quantities which shall include the entire cost of supply, handling, fabrication, transportation to the place of installation and installation of steel lagging and all other accessories.

(ii) For the measurement and payment purposes, the weight of the steel lagging will be based on the unit weight of the steel profile per linear meter (without any accessories) as specified in the relevant IS codes.

(iii) The measurement for payment for precast concrete lagging will be made of volume of precast lagging in m^3 used as approved by the Engineer. Payment will be made at the unit rate entered in the BOQ for supply, handling and installing precast concrete lagging complete in all respect. The cost of

formwork, concrete reinforcement, finishing and curing of precast concrete lagging is deemed to be included in the unit rate.

(iv) Measurement and payment for the backfilling with concrete behind steel/concrete lagging except unapproved overbreak shall be made at the unit rates per m^3 of concrete entered in the Bill of Quantity.

7.6.3 Lattice Girder

(i) Measurement for payment for supply, handling, fabrication and installation of the lattice girders will be of the weight of girders actually installed and approved by the Engineer. Payment will be made at the Unit Rates per MT entered in the Bill of Quantities, which shall include the entire cost of:

a) Supply, handling, fabrication, transportation to the place of installation and installation of steel lattice girders, bolts, nuts, cross-bracing, joint plates and all other accessories.

b) Surveying and marking the position of girders on the finished concrete surfaces.

(ii) For the measurement and payment purposes, the weight of the lattice girders will be based on the lengths of reinforcing bars used in their manufacture. Alternatively, the girders may be weight at site. Payment for nuts bolts, joint plates, spacer bar and all other accessories shall be deemed included in above and no separate measurement for these items shall be made.

7.6.4 Exclusions

(i) Rock bolts installed to hold the installed steel ribs in position will be measured for payment and paid for separately.

(ii) Shotcrete applied between or encasing the outer flange of the steel ribs/lattice girder will be measured for payment and paid for as set out in Chapter - Shotcrete.

(iii) Wiremesh used as lagging will be measured for payment and paid for as set out in Chapter – Rockbolts and Wiremesh.

7.6.5 No measurement for payment or payment will be made for the following:

(i) Structural steel supports which have to be replaced, repaired or re-erected as a result of contractor's operation. The contractor shall rectify or replace such steel ribs and lagging at his own expense.

(ii) Structural steel supports which have to be installed as a consequence of the contractor's non-compliance with approved excavation methodology as set out in the Contract.

(iii) Weight difference in case the contractor prefers installation of heavier or stronger steel supports or for additional ribs due to closer spacing than those approved by the Engineer.

(iv) Temporary supports installed by the contractor for his convenience and safety of his workmen/equipment during execution.

(v) Transport from the underground working zone back to the storage site, of any unused steel supports, and further storage to and/or removal from the Site.

(vi) Unused concrete lagging, ribs and other items/ materials.

(vii) Providing and fixing bulkhead in Steel/Precast Concrete lagging.

CHAPTER-8

ROCKBOLTS AND WIREMESH

INDEX

8.1 Scope of Work

(i) The specifications described herein-under relate to the work which includes all labour, materials, equipment and services required for the supply, installation testing and maintenance of rockbolts and grouted anchor bars as also the supply and installation of wiremesh and mesh anchors as specified herein or as shown on the drawings.

(ii) Rockbolts and wiremesh shall be furnished complete with all accessories and other materials necessary for their installation, stressing and grouting.

(iii) If directed or approved by the Engineer, the contractor shall supply and install flat steel plates or rolled steel sections to connect together two or more rockbolts.

8.2 Submittals

(i) At least 30 days prior to the commencement of excavation works, the contractor shall submit, to the Engineer, the following:

a) Full details of the type and quality of rock reinforcement which is proposed to used together with manufacturer's instructions and certificates, methods of installations and testing (including details of testing equipment).

b) Complete details concerning type, and materials of the post-tensioned rock bolts (tendons), together with manufacturer's instructions and certifications, methods of installation, corrosion protection, stressing equipment, grouting method and equipment, proposal for suitability and stressing tests and equipment.

(ii) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

(iii) Any amendments to the delivery schedule, proposed by the contractor as the work proceeds, will also have to be approved by the Engineer, and none of the above materials shall be brought to the Site without Engineer's consent. Any material brought to the site, which is not in accordance with the specifications provided herein shall be rejected and promptly removed from site at the Contractor’s cost.

(iv) The test certificate for the wires/strands for each lot of tendons shall be submitted by the contractor as obtained from the supplier to the Engineer for the approval prior to shipment.

(v) The contractor shall record the results of all tests performed on the rock bolts and post-tensioned rock bolts (tendons) prior, during and after their installation, register the readings taken at the load cells installed and submit these documents to the Engineer.

8.3 Standards

i) The work shall be carried out as per following Indian standards or,where not covered by these standards or, where not covered by these standards ,to their equivalent international standards(latest edition)

IS:11309 Method of conducting pull-out test on anchor bars and rock bolts

IS:13219 Rock Bolts for Mines (Cement Grouted- General Requirements

IS:13517 Rock bolts - Resin type

IS: 6066 Pressure grouting for rock foundations in river valley projects-Recommendatons

IS: 10270 Guidelines for design and construction of pre stressed rock Anchors

ii) in case of conflict between the above standards and their specifications given herein, the specifications shall take precedence.

8.4 General

(i) For the sake of convenience, the terms used in this Chapter are defined as follows:

(a) Rock reinforcement element is a general term for rock bolts, anchor bars, rock anchors and cable anchors.

(b) Rock bolt is a stressed (or tensioned) reinforcement element consisting of a rod, a mechanical or grouted anchorage , a plate and a nut for stressing by torqueing the nut or for retaining tension applied by direct pull. It is synonymous with “active rock anchor”.

(c) Grouted Anchor bar is an untensioned reinforcement element consisting of a rod embedded in a mortar or grout filled hole. It is synonymous with “passive rock anchor”.

(d) Individual rockbolting refers to the installation of reinforcement elements in localized areas of rock instability or weakness as determined during excavation. It is synonymous with “spot bolting”.

(e) Pattern rockbolting refers to the installation of reinforcement elements in a regular pattern over the excavated surface.

(f) Cable anchor is a tensioned reinforcement element consisting of high strength steel tendons with a stressing anchorage at one end and a mean permitting force transfer to the grout and rock at the other end.

(ii) The following types of rock reinforcing elements are proposed to be used:

(a) Expansion-shell type, grouted or ungrouted

(b) Resin-grouted type

(c) Grouted anchor bars

(d) Perfo type

(e) Water expandable bolts

(f) Self-drilling Anchors

(g) Cable Anchors

(h) Forepoles

(i) Drainage Holes and Relief Wells

(iii) The type, length, diameter, inclination and pattern of the rock bolts shall be as shown on the drawings or as approved by the Engineer.

(iv) Bearing plates shall be flat or dished steel plates of minimum dimensions of 150X150X10mm (for 18mm & 25mm dia rockbolts) and 200X200X12mm (for 32mm dia rock bolt). However, the actual size shall be as per construction drawing. The washers to be used shall be bevel or hemispherical. The nuts shall be heavy hexagonal type. Where the above components are to be used with grouted rockbolts, they shall be hot-dip galvanized, with a coating mass not less than 0.6 kg/m^2.

(v) All surfaces of the bearing plates, nuts, washers and wedges, and threads on the projecting ends of rock bolts shall be protected and lubricated with rust preventive compound.

(vi) When rock bolts are used in conjunction with wire mesh, the mesh shall be connected firmly to the bolts by means of extra steel plates and nuts. Wiremesh shall not be placed between rock and the bearing plate of the rockbolts.

(vii) If directed by the Engineer, rockbolts shall be provided with devices for load and deformation measurement.

(viii) The rock stabilizing and supporting measures to be undertaken during or after the excavation work for constructing the Works in a safe manner will be as determined or approved by the Engineer, based on the known or presumed behavior of the rock or ground.

(ix) In case of emergency or unforeseen exigency, the contractor is authorized and obliged to undertake independently such supporting measures, as he deems necessary without prior consent of the Engineer. In such cases the contractor shall inform the Engineer immediately.

(x) In underground works the installation of the rock bolts shall follow closely the excavation heading and they shall be installed before the next round of excavation advance. The contractor is responsible for the timely and proper installation of the rock supports and for checking and maintaining it until the final lining or structure is placed.

(xi) Rock stabilization measures required, as the permanent feature of the Works shall be installed as shown on the Drawings or as directed by the Engineer.

(xii) Nothing contained in this Section shall be construed to relieve the contractor from sole responsibility either for the safety of the Works or for liability for injuries to, or death of persons or damage to property, or of any of his obligations under this Contract.

(xiii) An adequate quantity of rock support materials and equipment, shall be stored by the contractor at the construction sites and be kept ready for immediate use at any time during the whole construction period.

(xiv) Since installation of bolts requires considerable skill, the contractor shall get professional advice from such specialized agencies/experts who shall assist him to achieve the required quality in carrying out the installation.

8.5 Testing and Monitoring of rockbolts

(i) The contractor shall furnish atleast two sets of testing equipment including hydraulic jacks, fixing device, hydraulic pump with manometer, extensometer and all necessary accessories. The testing equipment shall be capable of stressing the largest diameter rockbolts to the yield stress of the bolt.

(ii) Prior to the installation of rockbolts in the Works, a series of pull out tests shall be carried out in different rock types designated by the Engineer, and which will be representative of the rock expected to be encountered during the excavation, to prove the suitability of the rockbolts. During the pull-out test, both the load applied and movement undergone shall be measured. Atleast five tests shall be required for each combination of the rock type/installation condition to be able to assess the suitability of the rockbolt. The pullout tests shall be carried out sufficiently in advance of the installation of the rockbolts in the works so that, in the event that the proposed rockbolts do not meet loadstrain requirements, the contractor shall have time to furnish and test rockbolts of a different type as directed by the Engineer. The contractor shall maintain detailed records of the pull-out tests, the result of which will be used to establish relationships between rock quality and type of rockbolts and tensioning. During progress of the work, the contractor shall perform pull-out tests, stressing upto yield point, in the presence of the Engineer, on atleast 1 per 50 rockbolts installed. The Engineer will select the bolts to be tested. The rock bolts that form the part of the actual rock support system shall not be tested beyond 10% (ten percent) more than the design load.

(iii) Grouted expansion-shell type rockbolts shall be tested before grouting. Other type of rockbolts shall be tested after the mortar or resins have achieved their design strength.

(iv) If any rockbolt fails due to improper workmanship or defect in materials, the Engineer may order a test on all adjacent rockbolts and all rockbolts so failing shall be rejected, replaced and retested.

8.6 Drilling Holes and Preparation for Installation

(i) Holes for rockbolts and grouted anchor bars shall be drilled as specified herein and in accordance with the provisions set out in Chapter "Drilling and Grouting".

(ii) The diameter of each hole shall be in accordance with manufacturer's recommendations except for grouted anchor bars where the hole diameter shall be atleast 1.5 times that of the rod specified for the hole, however In case contractor's available equipment cannot drill hole of required diameter and it has to drill hole of higher diameter subject to approval of Engineer, the payment to contractor shall be limited to the diameter specified in these Specifications or construction drawings.

(iii) The length of drill hole shall be such as to receive the specified rockbolt and to provide for its satisfactory anchorage. The holes shall extend 15 to 20cm beyond the length of the rockbolts.

(iv) After drilling, each hole in compact, washable rock shall be washed out with clean water and cleaned by blowing out all drill cuttings and debris with compressed air. The holes in rock, which tend to swell or are interspersed with clay-filled fissures, shall be cleaned with compressed air only. The compressed air shall not contain any oil or other material preventing the bond.

Prior to installing the rockbolts which will be stressed, the rock surface adjacent to the hole shall be prepared for the bearing plate. When the surface is not perpendicular to the hole axis, bevel washer shall be placed between the bearing plate and the nut, or dished bearing plate and hemispherical washer used to ensure uniform bearing.

(v) If a rockbolt is not installed immediately after drilling the hole, the hole shall be washed and cleaned as stipulated above, immediately prior to installing the Rockbolt.

(vi) Fresh holes, as directed by the Engineer, shall be drilled by the contractor at his expense to substitute such holes as have been drilled out of place or alignment.

(vii) The rock surface around the drilled holes to receive the bearing plate shall be chipped smooth or be covered with a smooth quick set cement pad.

(viii) All bolts within 10m of a blasting operation shall be retightened to the approved torque within 4 hours after each blast. If it is found that any bolt does not take the required torque without anchorage slip, a new bolt shall be installed in the immediate vicinity of the unsatisfactory bolt at no extra cost to Employer.

8.7 Expansion shell type

(i) Expansion shell type rockbolts consist of a threaded solid bar fabricated from deformed steel bar of diameter 25mm or 32mm.

(ii) The rockbolts to be used shall be grouted or ungrouted as entered in the Bill of Quantities and as directed by the Engineer.

(iii) The Rock bolts shall be manufactured from reinforcing bar with Yield strength not less than 500N/mm^2 (The reinforcing bar shall comply with IS 1786).When coupler is used, the threading in the bar shall not reduce the effective diameter of bar. Coupler itself should be able to transfer at least 125 % of the yield load of the bar.

(iv) Rock bolts shall be furnished complete with all accessories and other materials necessary for their installation, fixing, stressing and grouting. Expansion shell shall be manufactured by a reputed agency only.

(v) The method and equipment used for installation, to effectively seat, and to stress the expansion-shell rock bolts shall be in accordance with the manufacturer's instructions and subject to the approval of the Engineer.

(vi) After initial installation, the contractor shall ensure that the rock bolts continue to act as effective supports by periodically testing the rock bolts and, if necessary, re -tightening to the directed torque or tension, till grouted.

(vii) Grouting of the expansion-shell rock bolts shall be performed after stressing the bolt. Grouting shall be performed as soon as practicable after, but in any case not later than 7 days, of rock bolt installation. The bearing plate shall be caulked around its perimeter and grout shall be introduced into the hole through a plastic tube fixed to the shaft and extended to outside through a hole provided in the bearing plate, at a pressure sufficient to fill completely the space around each bolt for the full length without any air-pockets remaining inside the hole. A grout return tube through another hole in the plate shall be provided to ensure full column grouting.

(viii) Cracks and fissures adjacent to the rock bolt which the grout is found to be flowing from, during the grouting operation, shall be plugged or caulked at the excavation surfaces.

8.8 Resin-grouted type

(i) Rockbolts shall consist of deformed steel bar 25 or 32mm diameter with a yield stress of not less than 500N/mm^2 or as shown on the drawings. Each bolt shall

have one end chamfered and the other end threaded with a coarse thread over a length of 200 mm.

(ii) After the hole is drilled and cleaned, fast setting resin cartridges as per drawing shall be placed and tamped to the bottom of the hole. The remaining hole shall then be filled with slow setting resin cartridges or with mortar.

8.9 Grouted Anchor Bars

(i) Grouted anchor bars shall be fabricated from a deformed reinforcing bar 25/32mm diameter with a yield stress of not less than 500N/mm^2 or as shown on the drawings.drawings.

(ii) Anchor bars shall be thoroughly cleaned before being placed in the drill hole. The hole shall be filled with grout constituting 1:1 cement/sand mix with low water cement ratio. Admixtures for fast setting and low shrinkage may also be required.

(iii) The anchor bars shall be protected against disturbance for a minimum time of 48 hours after installation or as required by the Engineer.

8.10 Perfo Type

(i) A bolt of the “Perfo” type consists of two perforated half round sections of sheet metal, which shall be filled with mortar, wired together and installed in a hole. A deformed steel reinforcing bar is inserted, manually or with a compressed air hammer into the tube causing the mortar to squeeze through the perforations and bond to the sides of the drill hole.

(ii) The sheet metal shall have a minimum wall thickness of 1mm.

(iii) The deformed steel bars shall be 18 or 25 or 32mm diameter, as shown on the drawings or as directed by the Engineer, of yield strength of not less than 500N/mm^2 which shall conform to IS: 1786. The bars shall taper at one end over a length of 50 mm to a point and shall be threaded at the other.

(iv) The mortar for filling the “perfo” tube shall consist of ordinary Portland cement, water and washed sand with a maximum size equivalent to that passing IS sieve 2.36mm. The cement to sand ratio shall be 1:1. The mix proportion, the method of mixing and accelerator admixtures, if used, shall be as approved by the Engineer.

(v) The following drillhole/tube/bar diameter relationships shall be maintained if not otherwise recommended by the manufacturer:

Drillhole Diameter	Tube Diameter	Internal Bar Diameter
38mm	31mm	25mm

48mm	40mm	32mm
54mm	47mm	36mm
72mm	63mm	48mm

(vi) "Perfo" type may be used as active as well as passive rock reinforcement. Should stressing of the bar be required, it shall be performed according to manufacturer's instructions.

8.11 Water expandable bolts

Water expanded rock bolts shall be manufactured from a mechanically reshaped steel tube with bushing pressed onto the ends, sealed through welding. The lower bushing shall have a flange to hold a face plate in place. High pressure water (< 30 MPa) shall be injected into the steel tube through a hole in the lower bushing. This causes the steel tube to expand and to form it to the irregularities in the drilled hole. A 200 mm long sleeve tube made of steel prevents the bar from swelling at the drillhole mount. As the swelling process occurs, the lower part of the steel tube shortens, pulling the face plate firmly against the rock face. The water pressure is released after installation and the water allowed to drain out of the expanded steel tube. The drillhole diameter has to be adjusted to suit the size of rock bolt according to the Manufacture's recommendations.

The water expanded rock bolts shall have a characteristic ultimate tensile strength of 120 kN.

8.12 Self-Drilling Rock-Bolts

Self-Drilling Rock-Bolts are a combined system of rock bolts and drill rod. During drilling, the bolt is used as the drill rod fixed with a drill bit. Rod and bit remain in the hole as a rock bolt, which is grouted through the flushing hole. In case of collapsing boreholes, this system still enables the installation of rock bolts. Self-Drilling Rock-Bolts shall have a minimum breaking load of 250 kN. The breaking load shall also apply to the thread, nut, bearing plate and coupling, if any. Self-Drilling Rock Bolts shall be used in ground conditions where the effective installation of other types of rock bolts is impossible. Self-Drilling Rock bolts shall be placed by drilling the rod into the ground without withdrawing the rod.

Self-Drilling Rock bolts shall be grouted through the flushing hole immediately after completion of the drilling operation. The grout mix, grouting pressure and quantity shall be determined by the contractor according to the ground conditions encountered and approved by the Employer.

8.13 Cable Anchors

8.13.1 General:

(i) Pre stressed rock anchors are tensioned reinforcement elements generally of higher capacity than the rock bolts, consisting of high strength steel tendons (made up of one or more wires, strands or bars) fitted with a stressing anchorage at one end and a mean, permitting force transfer to the grout and rock at the other end.

(ii) The contractor shall furnish and install Pre stressed rock anchors in area and to the extent shown on the construction drawings or as directed by Engineer

(iii) Installation of Pre stressed rock anchors for the work includes furnishing of wires/strands/rods of high yield strength for cable anchors of required quality as per relevant IS Standards with all accessories, such as anchors, studs, spacer, grout tubes, cement admixtures for grout, tensioning jack and other materials required for primary grouting, stressing, restressing, secondary grouting and testing including permanent corrosion protection of all elements of anchor, construction of concrete wall and drilling and testing of holes for anchors. Where relevant Indian Standards are not available equivalent international standards shall be followed.

(iv) The cable anchor materials, anchor parts, tensioning, installation and grouting procedure shall conform to relevant technical specifications covered under this document, construction drawings issued for this, and to the applicable Indian Standards or where not covered by these Standards, to the equivalent International Standard and the same shall be got approved from Employer before incorporating into the work.

8.13.2 Drilling

(i) Holes of required diameter at locations and to the depths and inclination (as shown on the construction drawings) shall be drilled at site or as directed by Engineer within the prescribed tolerances for alignment, inclination and size of the hole.

(ii) Depth of each hole shall exceed the total anchor length by at least 30 to 40 cm.

(iii) Holes shall be either drilled with rotary method with water flush or pneumatic percussion method with air and/or water flush or any other type such that the disturbances to the adjoining rock are minimal.

(iv) The sequence of drilling of holes shall be got approved by the contractor from the Engineer before starting the work.

(v) Use of bentonite, rod grease or other lubricants on drill rods will not be permitted.

8.13.3 Primary Consolidation Grouting/Cleaning/Water Testing

(i) After completion of the drilling in rock the hole shall be washed out with clean water at not less than 25 l/min until the returning water is clear, but at least for 10 minutes.

(ii) After drilling of hole water test shall be carried out and if water loss is found to be excessive, the hole shall be consolidation grouted in accordance with IS:6066. The hole shall be re drilled, water test repeated and the whole procedure repeated till a lugeon value of less than 1 is obtained, and the complete record maintained as specified in Technical specifications of the Bidding documents.

(iii) Consolidation grouting shall be carried out with neat Cement and water grout, the Water Cement ratio of which shall not exceed 0.4.

(iv) Admixtures as decided by Engineer shall be used, if required in desired quality to ensure smooth flow ability and compactness of the grout.

(v) Grout shall be injected at a maximum pressure of 0.1kg/cm^2 per meter depth of hole and injection shall continue to refusal. This pressure can be varied depending on the rock strata encountered subject to approval by the Engineer

(vi) Upon completion the drill hole shall be tightly plugged in suitable manner to prevent contamination by foreign matter and again washed and blown out immediately prior to inserting the anchor.

8.13.4 Material:

(i) The anchor tendon shall be composed of a number of seven wire type high strength stands as used in the Post-tensioned concreted and shall conform to IS: 6003-1979.

(ii) The strands shall be continuous without splices or couplers and shall be free of dirt, oil, rust and without mechanical damage.

(iii) The test certification for the wire/strands shall be submitted by the contractor, as obtained from the suppliers to the Engineer for the prior approval.

(iv) The contractor shall submit its design and procedure of preparation/installation of cable anchors for prior approval of the Engineer.

(v) Sheathing material shall be durable, rust & corrosion proof, flexible and water tight.

(vi) The anchorage shall be made of Carbon steel or other approved material. The limit load of the anchorage shall be greater than or at least equal to the failure load of the tendon.

(vii) The anchors head shall consist of a steel bearing plate/stressing plate, a pipe or collar of suitable diameter, shape and length as per drawings issued.

(viii) The anchors shall be shop fabricated and shall be free from dirt, dust or any other deleterious material. The anchor parts such as spreading, ring, spiral steel sheath, wire cap, clamping ring, Anchor block, Anchor base plate, Anchor head etc shall be either shop fabricated or field fabricated in accordance with the approved method and as directed by the Engineer.

8.13.5 Homing/Installation

(i) Installation procedure of cable anchors shall conform to IS: 10270.

(ii) The tendon shall be slowly inserted into the hole in such a manner as to prevent damage and tangling of the individual strands.

(iii) After being inserted, the anchor shall be fixed in position so that no displacement can occur during the grouting work. The tendon shall be centered in the hole with the help of spacers as specified in the drawings so that adequate covering of the steel with the grouting material is ensured.

8.13.6 End Anchorage

(i) Immediately following installation of the anchor into the hole, the primary grouting of the anchorage zone and outside the sheathing shall be carried out, the water cement ratio (W/C) of which shall be 0.35-0.40.

(ii) Grout mixture, use of admixtures for improving workability, mixing, grouting pressure & grouting equipment shall be subject to approval by the Engineer. The grouting equipment must permit grouting pressure upto 20 bars.

(iii) Packer/Breather pipes shall be used to ensure full grouting.

8.13.7 Stressing/ Tensioning of Cable Anchors

(i) Stressing of the anchors shall be performed only when the grout has achieved minimum cylinder strength of 250kg/cm square or only after the end anchorage/homing length/bond length has acquired the required strength. The minimum time between grouting of anchorage zone or concreting of anchor base and stressing shall be established during the anchor tests or as specified in drawings.

(ii) The anchors shall be first stressed to an initial load of about 10% of the anchor capacity to take care of any seating error.

(iii) The stressing shall follow a program drawn up by the Engineer which shall include the sequence in which the anchors are to be stressed the test loads, the stressing loads, any eventual stressing modifications to be made subsequently and tests to be carried out.

(iv) Immediately after the initial pull the anchor shall be stressed to the proof load (proof load= design load+ allowance of 10% relaxation) and the duration of proof loading shall be as specified by the Engineer.

(v) All the important conditions and observations during the stressing procedure, the loads applied and the elongation of the tendon with each load increment shall be recorded by the contractor.

(vi) The loss in pre stress shall be measured after three days and shall be within permissible limits. In case of loss exceeding limits, the anchor shall be restressed.

8.13.8 Secondary Grouting

As soon as possible after stressing or re-stressing has been completed and anchor has been accepted by the Engineer, the secondary grouting inside of the sheathing shall be performed to encase completely the strands for the full length of the hole.

8.13.9 Corrosion Protection

(i) Corrosion protection of cable anchors shall conform to IS: 10270.

(ii) The cable anchors shall be provided with protective corrosion seals over their entire length.

(iii) All permanent anchors shall be doubly protected for corrosion and sheathed prior to installation. Special care shall be taken to ensure that existing corrosion protection remains undamaged during insertion.

8.13.10 Pull Out Tests

Pull out tests upto yield strength of the steel shall be carried out conforming to IS codes on 100% of cable anchors. Allowances shall be made for the time dependent losses. All the test results shall be recorded.

8.14 Forepoling

8.14.1 General

Tunnelling in loose ground material is only possible due to the dome-like, three-dimensional load transfer in longitudinal tunnel direction across the temporarily unsupported tunnel arch. In order to reduce or avoid an overstressing of the arch and face, loose ground has to be reinforced by support ahead of the face. These support measures ahead of the face protect or prevent ground deformation. An excavation according to the theoretical profile induces shorter span and hence the displacements in the tunnel and on the surface are reduced to a minimum. The installation of advance support depends to a high extent on the quality of workmanship. Forepoling is an auxiliary support element required as safety precaution and overhead protection for the application in the actual working area of the tunnel excavation works. Forepoling shall be applied in rock and soil conditions, which tend to produce overbreak, collapses or material inflows immediately following excavation. Forepoling may be applied locally or systematically, as the circumstances require.

8.14.2 Material and Equipments.

Steel pipes with an inner diameter 30 to 35 mm shall be used unless otherwise specified. Wall thickness of steel pipes shall not be less than 3 mm unless otherwise specified. The length of the steel pipes shall be at least 1.50 m longer than the instructed length of round.

8.14.3 Types of Forepoling

8.14.3.1 Spiles

Spiles are corrugated reinforcement bars with a diameter of approximately 25-32 mm and a length upto 5m. The same shall be driven by a special adapter on a boom at the spacing of 20 to 30 cm distances.

8.14.3.1.1 Predrilled and Ungrouted Spiles

Ungrouted spiles are made of corrugated reinforcement rods with a diameter of approximately 25-32 mm and a length upto 5m. The same shall be driven at the spacing of 20-30 cm and remain ungrouted.

8.14.3.1.2 Grouted Spiles

Grouted spiles cannot be applied in loose ground as no stable borehole for the insertion of the grout hose can be achieved.

8.14.3.2 Ungrouted, Self-Drilling Forepoling bars

Self-drilling forepoling bars are hollow steel rods with a diameter of 25-38 mm and a length of 3 m or longer (which can be extended by couplings via the external continuous thread) and have a single-use drill bit. The same shall be installed by a boomer at the spacing of 20 to 30 cm and remain ungrouted.

8.14.3.3 Grouted Self-Drilling Forepoling Bars

The ideal type of installation for grouted self-drilling forepoling bars uses grout as the flushing liquid. This type of installation ensures the best bonding between the ground and the forepoling bar. To use cement grout for flushing, the drilling jumbo has to be equipped with a special cooling system and an adapter between the hammer and the rod is required to convey the grout into the flushing duct.

8.14.3.4 Ungrouted forepoling pipes

Forepoling pipes are of steel with a diameter of approximately 50 mm and of wall thickness 3-5 mm, with a welded on tip or a skew open end. They are installed with lengths of 3-5 m in fine to medium grained grounds either driven or inserted in pre-drilled (partly collapsed) holes in a dense pattern of 20 to 30 cm. They remain ungrouted.

8.14.3.5 Grouted Forepoling pipes

Forepoling pipes of 3 to 5 m lengths with holes or slots for grouting purposes are installed in the same manner as the previously described ungrouted forepoling pipes and are grouted in the following working step. Good grouting is achieved between the grout and the ground and exact profile shape is the result.

8.14.3.6 Forepoling for DRESS Methodology

Fore-poling (casing) of steel pipes shall be provided ahead of the face before excavation of the face using the hydraulic drilling rig. The crown of the tunnel above the springing line shall be supported with 12 m long steel pipe fore-poles of 114.30 mm outer diameter with 6 mm thick wall & in an upward direction of 6 degree over the R1rib of the block. The fore-poles shall be spaced @ 400 mm c/c spacing or as shown on drawings.

8.14.4 Execution of Work

(i) The aim of any advance support is to install the support elements into the ground ahead of the face in the shape of the excavation profile, so that the excavation profile can be achieved without major overbreak.

(ii) The use of steel ribs is a precondition for the installation of the advance support. The combination of steel ribs with shotcrete forms the support of the advance-support at the place of the nearest rib to the face. The effectiveness of the advance support also depends on the length of round. Advance support with forepoling bars or spiles is only effective with lengths of rounds of less than 1.2 meters in loose round.

(iii) When installing advance-support, the shotcrete lining above the steel rib shall be kept open for installation of forepoling. Only once the advance support has been placed, shall the shotcrete be applied at these locations, in order to achieve an appropriate support and embedment for forepoling at the steel rib next to the face. Attention shall be taken so that forepoling is also embedded in shotcrete between the steel rib next to the face and the tunnel face, which will result in a minimum overbreak during the excavation of the next round.

(iv) As the grout mortar shall have sufficient strength before opening the next excavation step, the use of accelerated cement is favourable. The use of cement with accelerates increases time available for cleaning and wear. In certain cycles normal cement can be used if the working cycle can be planned in such a way that the time between grouting and the opening of the face can be used for activities such as the installation of rock bolts or the invert arch.

(v) The selection of the length of advance-support shall consider that the steel rods or pipes must have sufficient support lengths in the ground and on the steel ribs.

(vi) Forepoling pipes shall not have grout holes for approximately 1 m at its ends so that damage to tunnel profile is avoided. Prior to grouting, the mouth of the boreholes shall be sufficiently sealed in order to achieve sufficient grouting embedment of the pipes. In order to enable a certain build up grouting pressure, a reusable mechanical packer including a tap shall be attached at every end of the pipes.

(vii) In loose ground, the flushing of self-drilling rods shall be carried out by means of cement grout, as this method warrants best results without any loosening effects.

8.14.5 Tests and Properties

The correct location with regard to the required excavation profile will be checked and recorded.

8.14.6 Auxiliary Work

All auxiliary works listed to be included in the prices for underground excavation shall also be applicable for the forepoling installation works. Further to the above the following works and operations shall also be considered as auxiliary works included in the prices.

- Provisions of equipment for installation of forepoling.
- All testing of materials.

8.15 Drainage Holes and Relief Wells

(i) Drainage holes and relief wells shall be provided where shown on the Drawings. Drainage holes and relief wells shall be drilled only after final grouting of adjacent rock, except holes drilled for drainage adjacent to the tunnel face.

(ii) Drainage holes shall be drilled in rock for the release of water pressure in water-carrying zones in underground excavations and open excavations, behind concrete and shotcrete structures, and elsewhere as shown on the Drawings. The hole diameter shall be at least 35mm, but drainage holes with a diameter of up to 100 mm may be required. The holes shall be drilled either by means of percussion drilling or rotary drilling and may be vertical or inclined in any direction. Such holes will normally be equipped with 65 mm strainer pipes of PVC or approved corrosion resistant material.

(iii) If the outlet of a drainage hole is located adjacent to a grouted zone an initial part of the hole may be first drilled and grouted and subsequently re-drilled.

(iv) Relief wells in soil shall be drilled with a minimum inner diameter of 200 mm. The holes shall be equipped with strainer pipes of PVC or approved corrosion resistant material with an inner diameter of 100 mm.

(v) Special centring devices shall be used when the strainer pipe is installed and the annular space around the strainer pipe shall be carefully filled with sand of a gradation to be approved by the Engineer. In special cases the strainer pipe may be surrounded by a filter fabric.

(vi) Adequate drainage arrangement for seepage water in the power house with connecting pipes to sump well shall be provided. The sump level shall be such that it is possible to drain out the machine and the draft tube for inspection and maintenance.

(vii) Six to eight, drainage holes of 75 mm diameter up to 24 m length depending upon the site strata, in upward inclination of 15 degree shall be drilled with a hydraulic rig (Fore-poling Machine) using DTH hammer for DRESS Methodology. The rock to be encountered ahead shall also be assessed with the rate of drilling and rock cuttings of the holes. Mild Steel pipes of 50 mm diameter 12 m grouted & 12 m perforated protected with geo-textile (impervious felt) shall be provided in the drilled drainage holes to avoid the blockade of drainage system. These drainage holes shall be provided in alternative fore-poling blocks

8.16 Wire Mesh and Mesh Anchors

8.16.1 Chain Link Fabric

(i) Chain link fabric shall be installed in surface or underground construction sites generally without shotcrete, to protect surfaces from which loose pieces of rock or cobbles may fall or for fencing purposes.

(ii) Chain link fabric shall conform to the requirements of IS: 2721 (latest revision) for galvanized steel chain link fence fabric. The fabric shall have a mesh size of approximately 50mm X 50mm, and a wire diameter of 4mm or as shown on the drawings.

(iii) The fabric shall be clean of mud, grease, oil or other foreign matter.

8.16.2 Welded Wiremesh

(i) Welded wiremesh shall be installed in surface and underground excavation as reinforcement for shotcrete, usually in combination with rockbolts. It may also be used with steel ribs, when it shall be laid over the outer flange of the rib and pinned or fixed to the excavated surface between the ribs where necessary.

(ii) Welded wiremesh shall conform to the requirements of IS: 1566 (latest revision). The fabric shall have a square mesh of 100 to 200mm spacing, made of wires having yield strength not less than 275 N/mm^2 and diameter between 3 to 5mm or as shown on the drawings.

(iii) Where possible, the welded wiremesh shall be placed at the same time as rockbolts are installed. It shall not be placed between the rock surface and bearing plates of rockbolts, but shall be placed over the heads of rockbolts and fastened to them by separate plates and nuts. Sufficient intermediate mesh pins 12mm dia, 300mm long driven into under size holes, or if directed by the Engineer, additional rockbolts, shall be placed to ensure that the mesh is drawn close to the excavated surface so that when shotcrete is applied subsequently, the mesh neither sages nor vibrates excessively and impairs the effectiveness of the shotcrete.

(iv) In case the welded wiremesh is placed at such locations where rockbolts have not been provided, wiremesh anchors of a type acceptable to the Engineer shall be used to secure the edges of wiremesh tight to the rock surface to provide anchorage at overlaps and to provide intermediate support. The wiremesh pins shall have a minimum length of 450mm.

(v) The use of wooden pegs on pins for fastening the wiremesh to the rock surface will not be permitted.

(vi) Welded wiremesh shall be firmly stretched between the rockbolts. Care shall be taken to ensure that air pockets are not formed behind the wiremesh, when used as reinforcement for shotcrete.

(vii) Overlaps in the wiremesh shall not be less than 300mm.

8.17 Measurements and Payments

8.17.1 General

The Unit Rates entered in the Bill of Quantities shall be applied regardless of the work being performed on the surface or underground, regardless of the excavation method used. For definitions of the various zones mentioned above, refer Chapter -Underground Excavation.

8.17.2 Rockbolts and Grouted Anchor Bars and Pre-stressed Cable Anchors

8.17.2.1 Testing and monitoring of rockbolts

(i) Payment will be made for the supply and installation of all rockbolts used in pull out tests, provided always that the rockbolts tested comply with these specifications. Measurement for payment and payment will be the same as for rockbolts used for the Permanent Works.

(ii) No extra measurement for payment or payment will be made for the testing equipments and carrying out tests and the cost thereof shall be included in the Unit Rates provided in the Bill of Quantities.

8.17.2.2 Expansion-Shell Type

Measurement for payment for expansion shell type rockbolts will be made separately for ungrouted and grouted rockbolts and will be of the total length of bolts including threaded portion installed and approved by the Engineer. Payment will be made separately for respective bar diameter at the Unit Rate per linear meter entered in the Bill of Quantities which shall include the entire cost of :

a) Furnishing and installation of expansion shell type rockbolts with all accessories.

b) Stressing and load testing.

8.17.2.3 Resin Grouted Type

Measurement for payment for resin grouted type bolts will be of the total length of bolts including threaded portion installed and approved by the Engineer. Payment will be made separately for respective bar diameter at the Unit Rate per linear meter entered in the Bill of Quantity, which shall include the entire cost of :

a) Furnishing and installation of quick set resin cartridges.

b) Furnishing and filling the hole with the mortar or slow-set resin.

c) Furnishing and installation of reinforcing steel bars, and bearing plates and all other accessories.

d) Stressing and load testing.

8.17.2.4 Grouted Anchor Bars

Measurement for payment for grouted anchor bars will be of the total length of the bars including threaded portion installed and approved by the Engineer. Payment will be made separately for respective bar diameter at the Unit Rate per meter entered in the Bill of Quantities, which shall include the entire cost of:

a) Furnishing, cutting, bending and installing reinforcing steel bars with or without welded hooks.

b) Furnishing of grout materials (resin or cement mortar) and filling the drill holes.

c) Testing.

8.17.2.5 “Perfo” Type

Measurement for payment for “Perfo” Type bolts will be of the total length of bolts including threaded portion of the same bar diameter installed and approved by the Engineer. Payment will be made separately for each bar diameter at the Unit Rate per linear meter entered in the Bill of Quantities, which shall include the entire cost of:

a) Furnishing and installation of perforated tube, steel bar and bearing plates.

b) Furnishing all other accessories and fittings.

c) Furnishing and filling with mortar.

d) Load testing.

8.17.2.6 Water Expandable Bolts

Measurement for payment for water expandable rock bolts will be of the total length of the bars of the same diameter installed and approved by the Engineer. Payment will be made separately for each bar diameter at the unit rate per meter entered in the bill of quantities, which shall include the entire cost of:

a) Drilling of the holes

b) Washing and cleaning of the holes

c) Supplying and installing water expandable rock bolts with all accessories as recommended by the manufacturer.

d) Load/pull out testing.

8.17.2.7 Self-Drilling Rock-Bolts

Self-Drilling Rock-Bolts will be measured as running meter length installed and shall include Load/pull out testing and all accessories as recommended by the manufacturer.

8.17.2.8 Forepoles

(i) Measurement for payment for structural sections will be of the weight of the sections actually installed. Payment will be made at the Unit Rates per MT entered in the Bill of Quantities.The weight of the structural section will be computed using the nominal unit weight per meter as specified in the relevant IS codes.

(ii) Measurement for payment for spiles, forepoling bars and forepoling pipes will be of the weight of the material actually installed. Payment will be made at the Unit Rates per MT entered in the Bill of Quantities.The weight of the spiles, forepoling bars and forepoling pipes will be computed using the nominal unit weight per meter as specified in the relevant IS codes.

(iii) The unit rate quoted for the spiles, forepoling bars, forepoling pipes and structural sections in the Bill of Quantities shall be deemed to include the entire cost of supply, handling, storage, cutting, placing, drilling including grouting etc wherever required.

8.17.2.9 Cable Anchors

8.17.2.9.1

Measurement for payment and payment for cable anchors shall be made by multiplying length of the cable anchor as shown on the drawings by the rate per linear meter entered in the bill of quantities. The rate shall include the entire cost of:

(i) Furnishing of tendons with all accessories such as anchor, sheathing, grout tube, cement, admixture for grout, tensioning jack etc.

(ii) Furnishing of all tools and plants, scaffolding, labour and materials required for installing tendons at locations where directed by the Engineer.

(iii) Drilling, re-drilling ,staging and installing the tendons.

(iv) Water testing.

(v) Stressing and load testing.

(vi) Corrosion treatment, drilling, material, accessories, fittings, installation, stressing, primary and secondary grouting and load testing and capping, complete in all respects.

8.17.2.9.2

For additional grouting of the hole, if required due to geological reasons, payment will be made at the Unit Rate per MT entered in the Bill of Quantities, which shall include the entire cost of provision, delivery, transportation, storage and complying with all requirements specified with the approval of Engineer.

8.17.2.10 Miscellaneous Metal Pieces used in Conjunction with Rockbolts

(i) Measurement for payment for miscellaneous metal pieces such as small steel beams, steel plates, steel cables, etc., will be of the weight of steel actually installed.

(ii) Payment will be made at the Unit Rate per MT entered in the Bill of Quantities, which shall include the entire cost of supply and installations.

8.17.2.11 No measurement for payment will be made for the following:

(i) Drilling of holes for all types of rockbolts (excluding self driven forepoles) will be paid separately as set out in Chapter “Drilling and Grouting.

(ii) Loose and rejected rockbolts, rockbolts which fall out during trimming, excavation and rockbolts which are otherwise damaged, or displaced as a result of contractor’s operations. The contractor shall replace such rock bolts at his own expense. If the rock conditions in the underground excavation

require an immediate installation of the rockbolts in the heading face, which will be destroyed later as the excavation advances, deviation from this rule may be granted after a mutual agreement between the Engineer and the contractor.

(iii) Rock bolts which have to be installed as a consequence of the contractor's non-compliance with the approved excavation methodology as specified in Chapter "Underground Excavation".

(iv) Difference between the theoretical length of the grouted anchor bars as shown on drawing and the effective length actually installed due to over excavation or overbreak.

(v) No payment shall be made for abandoned holes, test anchors and re- drilling.

(vi) Cement and additives for grout mixes, resins, quick set cement for bearing plate, pads and rust protection materials.

(vii) Engaging specialized agency/expert where considerable skill is required.

8.17.3 Wire Mesh

8.17.3.1 Chain Link Fabric.

(i) Measurement for payment for chain link fabric will be of the net area (without overlaps) actually installed. The weight will be computed using the nominal unit weight per m^2 as stated on the certified copies of manufacturer's reports, which the contractor shall submit to the Engineer, or, in absence of such reports, by direct weighing on the Site. Overlaps in chain link will not be measured for payment.

(ii) Payment will be made at the Unit Rate per MT entered in the Bill of Quantities, which shall include the entire cost of supply and installation of chain link fabric including overlaps, and the provision of all necessary accessories for fixing, such as steel pins, extra plates, nuts & bolts for fastening. Cost of overlap of chain link is deemed to be included in the unit rate of chain link.

8.17.3.2 Welded Wire Mesh

(i) Measurement for payment for welded wiremesh will be of the net area (without overlaps) actually installed. The weight will be computed using the nominal unit weight per m^2 as stated on the certified copies of manufacturer's reports, which the contractor shall submit to the Engineer, or, in the absence of such reports, by direct weighing on the site. Overlaps of welded wiremesh shall not are measured for payment.

(ii) Payment will be made at the Unit Rate per MT entered in the Bill of Quantities, which shall include the entire cost of supply and installation of welded wire mesh, including overlaps, and the provision of all necessary accessories for

fixing, such as steel pins/mesh anchors and extra plates and nuts for fastening to rockbolts. Cost of overlap in wiremesh is deemed to be included in the unit rate of welded wiremesh.

CHAPTER – 9

SHOTCRETE

INDEX

9.1 Scope of Work

(i) The specifications described herein under relate to the work which includes all labour, materials, equipment and services required for the shotcrete work to be carried out by the contractor under this contract.

(ii) The shotcrete work shall be performed to the dimensions as shown on the drawings or as otherwise directed by the Engineer.

(iii) The approval given by the Engineer to the contractor's equipment or their operation or of any construction methods shall not relieve the contractor of his full responsibility for the proper and safe execution of Shotcrete Work or any obligations under this contract.

(iv) The contractor shall design the mix, furnish materials, place, cure shotcrete as necessary to provide temporary or permanent protection and/or support of excavated surfaces either in open or underground excavations.

(v) Shotcrete shall be placed with or without steel wire mesh reinforcement, as directed, and may be used in conjunction with rockbolts, steel ribs and other rock supporting measures.

(vi) The contractor shall maintain adequate stockpiles of materials for shotcrete for immediate use in cases of emergency. Any damage or delay resulting from shortage of such materials shall be the contractor's entire responsibility.

(vii) Methods and workmanship in the application of shotcrete shall be in accordance with IS: 9012 or BS 882.

9.2 Submittals

(i) Within 30 days from the date of issue of the Letter of acceptance, but before procuring or mobilizing to the Site, the equipment, the contractor shall submit to the Engineer, updated and detailed plans and descriptions, of the following:

(a) Batching and Mixing Equipment:

Description and details of the equipment, which the contractor intends to use to determine and control the quantity of shotcrete ingredients and mixing thereof into uniform mixture.

(b) Placing Equipment:

Full details of the equipment to be used for placement of shotcrete and details of standby equipment.

(c) Details of method and equipment which the contractor proposes to use to control the temperature of aggregates and water during extreme hot and cold weather conditions.

(d) Details of methods to be employed for controlling the thickness of the layers of shotcrete applied (e.g. plug gauges or boreholes).

(ii) At least 30 days in advance of any shotcrete work being carried out on the Site, the contractor shall submit, to the Engineer, the following:

(a) Notification of any admixture and pozzolana, which the contractor proposes to use, manufactures thereof and information about the chemical names of the principal ingredients and the effect of under or over dosage.

(b) Description and details of methods which the contractor proposes to adopt for shotcreting.

(iii) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

9.3 Standards

(i) The shotcrete materials, production, methods, testing and admixture shall conform to the following latest Indian Standards or, where not covered by these Standards, to the equivalent International Standards:

IS: 456 Code of Practice for Plain & Reinforced concrete.

IS:269 Specification for ordinary Portland cement.

IS:1489 (Pt-1) Specification for Portland Pozzoland cement (flyash based).

IS:383 Specification for coarse and Fine Aggregates from natural soruce for concrete.

IS: 432 Specification For Mild Steel And Medium Tensile Steel Bars And
(Part I & II) Hard-Drawn Steel Wire For Concrete Reinforcement

IS: 516 Method of test for Strength of concrete.

IS:9012 Recommended practice for shotcreting.

IS:9103 Concrete Admixtures.

IS:8112 Specification for 43-grade ordinary Portland cement.

IS:2645 Specification for integral cement water proofing compound.

(ii) In case of conflict between the above standards and the specifications given herein, the specifications shall take precedence.

9.4 Definitions

9.4.1 Shotcrete

Shotcrete, for the purpose of this Work, is defined as wet mix of cement concrete applied from a spray nozzle by means of compressed air. The Engineer may, in exceptional cases, allow use of dry mix for shotcreting, if acceptable. Shotcrete shall contain an approved admixture suitable to attain quick set and high early strengths as specified herein.

9.4.2 Steel fibre reinforced Shotcrete (SFRS)

Steel fibre reinforced shotcrete (SFRS) is defined as a mortar or concrete, containing discontinuous discrete steel fibres, which are pneumatically projected at high velocity on to a surface.

9.4.3 Rebound

Rebound is defined as the aggregates and cement or wet shotcrete which bounces away from a surface against which shotcrete is being projected.

9.4.4 Layer

Layer is a term used for a discrete thickness of shotcrete built up from a number of passes of the nozzle and allowed to set.

9.5 Materials

(i) Shotcrete shall be composed of cement, aggregates, water and approved admixtures as specified herein.

(ii) Cement shall be ordinary portland cement (43-grade) conforming to the requirements of relevant Standards or as specified on the drawings.

(iii) Aggregates shall conform to the requirements of relevant Indian Standards. The aggregate size shall not exceed 10mm.

(iv) Aggregates shall be furnished by the contractor from a source accepted by the Engineer, but acceptance of source by Engineer shall not be construed as constituting the acceptance of all aggregates to be taken from that source or grading or aggregates to be in conformance with contract.

(v) Air used for spraying shotcrete shall be clean and free of oil.

(vi) Admixtures shall be used to develop fast setting and high early strength of shotcrete, to ensure good workability, low pumping pressure, adequate slump retention and low rebound, as approved by the Engineer, conforming to

requirements of relevant standards. Only proven admixtures which meet the requirements of the specifications on field trials and long-term satisfactory performance shall be used.

(a) Superplasticisers: Shall meet the requirements of ASTM C 494 type F shall be compatible with cement & accelerator. Superplasticisers shall be added at the batching plant to keep the shotcrete mix workable during transportation and to ensure good pump ability at an acceptable low water cement ratio. The Superplasticisers shall be free of chlorides.

(b) Accelerators: Only liquid accelerators shall be used. The accelerator shall be added at the nozzle. The maximum dosage shall not exceed 6 % (by weight of cement)

Testing of accelerators in accordance with this specification with regard to setting time and early strength gain shall be in accordance with the following

- Initial set of cement/admixture paste 3 min
- Final set of cement/admixture paste 12 min
- 3-hour strength of shotcrete 0.7 N/mm^2
- 8-hour strength of shotcrete 4.0 N/mm^2
- 24-hour strength of shotcrete 10.0 N/mm^2

9.6 Mix Design and proportioning

(i) The type/class of shotcrete to be used in a particular location shall be as per drawings and as directed by the Engineer.

(ii) The mix proportions of cement, aggregates and permitted admixtures in each class shall be determined by the contractor and shall be subject to the approval of the Engineer. The mixes shall be such as to permit placement without excessive rebound and segregation.

(iii) The admixtures shall have proven compatibility with the cement make and type so as to ensure initial and final setting time as 3 and 12 minutes respectively. The contractor shall supply, to the Engineer, all the necessary test results and reports to confirm compatibility.

(iv) The water content of the mixes shall be limited to prevent sloughing. The water-cement ratio of fresh shotcrete in place shall be between 0.32 and 0.45.

(v) The mixes shall be such that aggregate gradation and cement content after placing are as those obtained from samples taken from test panels produced

from approved trial mixes. The constituents shall be uniformly dispersed throughout the mix.

(vi) The proportion of admixture shall be as determined by engineer.

(vii) Proportioning of aggregate and cement shall be only by weigh batching.

(viii) The shotcrete shall meet the following compressive strength requirements or as shown on the drawings at the trial mix stage.

(a) 45 kg/cm^2 at 8 hr.

(b) 125 kg/cm^2 at 72 hr.

(c) 250 kg/cm^2 at 28 days.

The Compressive strength after 7 days shall be 70% of the specified strength of 28 days. If shotcrete is to be carried out in the rear zone 8 hours strength of shotcrete shall not be insisted by the Engineer.

(ix) Moisture content of the combined aggregate at the time of mixing with cement shall not exceed 6% (six percent) by weight of the oven dry aggregate.

(x) Mixed material shall be used within 90 minutes after adding cement.

(xi) The accelerating admixture, if in dry state, shall be added immediately after depositing the materials in placing equipment and shall be accurately proportioned and thoroughly mixed with other ingredients. If in liquid form, the admixture shall be accurately proportioned into the water supply at the application nozzle.

(xii) Mix proportions shall be varied, when required by the Engineer, to obtain required strength of shotcrete, to maintain rebound to the minimum and to meet other requirements of contract. The contractor shall notify to the Engineer of all variations to the mixes

9.7 Quality Control and Testing

The quality control and testing of shotcrete will be carried out by Contractor in presence of Engineer or his representative. The contractor shall prepare test panels, determine mix proportion as set out in para 9.6.

The following procedure or any other procedure approved by the Engineer for designing and testing the shotcrete mix shall be followed.

9.7.1 Making Test Panels

(i) At least 30 days prior to the placing of any shotcrete in the Works, the contractor shall undertake preparation of the trial mixes, in the presence of the Engineer, using the methods described below.

(ii) The contractor shall prepare three test panels of minimum size 75cm X 75cm and 80mm thick, for each mix design and for each type of plant. They shall be

sprayed from each position required in the works, one down hand, one horizontal and one overhead with a layer thickness appropriate to that position and with reinforcement as directed by the Engineer. Panel moulds shall be formed from plywood, at least 20mm thick, be adequately braced and be held rigidly in position.

(iii) For the purpose of routine quality control during the execution of Work, control test panels of the same size as for the trial mix testing shall be sprayed. For the first 50 m^3 of shotcrete applied in each underground excavation heading, one test panel shall be prepared. Further, the test panels will be limited to one per nozzleman per week or one per 100 m^3 of material placed, as directed by the Engineer. However, the contractor shall ensure the frequency of sampling and testing as set out above. The test panels shall be constructed alongside the area of placement and at same angle and shall be sprayed by each nozzleman in rotation so that the tests shall represent the quality of the shotcrete being placed by each nozzleman. The test panels shall be stored and cured alongside and under similar conditions to the shotcrete placed in the works.

(iv) The pressure at which the shotcrete shall be applied to the test panels shall be the same as will be used in actual works at the place of application.

(v) Shotcrete from both the trial mix and the routine quality control test panels shall be tested by contractor as described hereunder in presence of Engineer or his representative.

9.7.2 Testing for Compressive Strength

(i) Nine, 50mm diameter cores, shall be cut by the contractor from each test panel at right angles to the plane of the panel approximately 48 hours after the panel has been sprayed. Cores shall not be taken within 10 cm of the edges of the panel.

(ii) First three cores shall be compression tested at 3 days, second three cores at 7 days, and the remaining three cores at 28 days. The testing will be carried out by Contractor in presence of Engineer.

(iii) The cores shall be stored, cured and tested in accordance with relevant standards. All cores shall be suitably labeled to identify them with the panels from which they have been taken, and the location in the works to which they relate.

(iv) The appropriate compressive strength requirement for each set of two, 28 days cores, shall be satisfied if:

(a) Each core has a compressive strength equal to or greater than that specified, or

(b) The average compressive strength of the two cores is equal to or greater than that specified and the difference between the strengths is less than 20% of the average.

(v) In case any of the cores reveal defects such as lack of compaction, dry patches, voids or sand pockets, the Engineer may require further cores to be taken from the remainder of the panel(s) or he may reject the procedure used to make the defective test panel and require that a replacement test panel be made with a modified procedure.

9.7.3 Conducting other Routine Tests during the Works

(i) When directed, and at specified locations selected by the Engineer, the contractor shall make 25mm diameter probe holes to determine the thickness of the shotcrete.

(ii) When directed, and at locations indicated by the Engineer, the contractor shall cut sets of 50 mm diameter cores from the finished Shotcrete, which shall be tested by the Engineer using the same procedure as on cores taken from the test panels.

(iii) Core holes shall be filled by hand with well rammed dry-pack mortar of a similar mix to that used for Shotcrete.

(iv) Where directed by the Engineer, the compressive strength of the shotcrete shall be assessed by non-destructive testing using the “Schmidt Concrete Test Hammer”, calibrated by reference readings taken on the shotcrete at locations where cores are to be taken. At least ten readings shall be taken for each strength assignment.

(v) Soundness shall be tested by hand hammer. A hollow response indicates a possible lack of bond or other defect.

(vi) The measurement of in-situ penetration resistance shall be carried out by using spring-loaded penetrometer or similar suitable equipment.

(vii) During the progress of the Work, the contractor under the Engineer’s supervision, shall perform tests for the determination of rebound volume. The Engineer will determine the number of such tests as needed to obtain reliable results.

9.8 Proficiency of Workmen

(i) Nozzlemen shall have had sufficient previous experience in the application of coarse aggregate shotcrete or shall work under the immediate supervision of a foreman or instructor having such experience. The nozzlemen shall be approved by Employer from the panel submitted by the contractor.

(ii) Each crew shall demonstrate acceptable proficiency in the application of shotcrete to test panels as set out in Para-9.7.1 hereof before beginning production Work.

(iii) The acceptable shotcrete shall consist of a dense uniform concrete without major rebound inclusions and without discernible weakness of bond between layers. The nozzlemen shall shoot shotcrete with a uniform consistency and at the wettest consistency short of the sag point. The nozzle shall be held at a predetermined distance and position so that the stream of flowing material shall impinge as nearly as possible at right angles to the surface to be covered.

9.9 Surface Preparation

(i) When shotcrete is to be applied to excavated surfaces immediately after blasting, the surfaces shall be prepared by a minimum of scaling, as required by the Engineer, followed by washing with clean water. All surfaces shall be wet, clean and free of rebound, at the time of application of shotcrete. For all other shotcrete application, the surfaces to be treated shall be thoroughly sluiced with air and water jet or cleaned by other means approved by Engineer to remove all traces of dirt, mud, debris, oil, loose particles, rebound or loose rock and any other deleterious material. The surfaces shall be kept moist until shotcrete is applied.

(ii) Where water flows from the rock against which shotcrete is to be placed and when water cannot be sealed off by shotcreting alone, the water shall be excluded from the area by caulking or diverted by pipes, pans or other approved means in such a manner that the shotcrete will be unaffected by action of the water through percolation, by hydrostatic pressure or erosion.

(iii) A layer of shotcrete, which is to be covered by a succeeding layer, shall first be allowed to take its initial set and shall have all laitance, loose material, dirt or other deleterious material and rebound removed by brooming, sluicing or other means acceptable to the Engineer.

(iv) Shotcrete surfaces shall be kept moist until either the succeeding layer of shotcrete is applied or alternatively the curing requirements set out in this section have been observed.

(v) At any time during surface preparation, the Engineer may order the contractor to apply shotcrete to isolated areas before proceeding with surface preparation.

9.10 Mixing and Application

(i) Shotcrete materials shall be accurately weigh-batched before mixing. Aggregates shall be thoroughly mixed without the addition of water before being deposited in the placing equipment. Cement shall be added not more than 1-1/2

hours before application. Mixes which are not applied within 1-1/2 hours of adding cement shall be discarded. Rapid-hardening additive shall be accurately proportioned.

(ii) Shotcrete shall not be applied to any surface without the acceptance of the Engineer. Should contractor consider that any surface requires shotcreting urgently, he shall immediately inform the Engineer, who will give a decision as soon as possible.

(iii) In general, the minimum thickness of shotcrete in any one layer shall be 25 mm. The maximum thickness of shotcrete applied in any one layer at any location shall be 50 mm, to avoid gliding of fresh concrete before laying of 2nd layer of shotcrete, 1st layer shall be allowed to take its initial set and have all loose material removed.

(iv) The Engineer shall examine rock faces following blasting and scaling. On the basis of such examination, the Engineer may require immediate shotcreting of surfaces, in which case shotcrete shall be applied within 4 hours of blasting and before drilling the next round. Where very poor rock conditions are anticipated, the Engineer may require that shotcrete equipment be available before blasting so that shotcrete can be applied with the minimum of delay.

(v) Shotcrete, other than that placed immediately after blasting, shall not be placed in any area until all blasting within 30m of the area has been completed, unless otherwise approved by the Engineer.

(vi) Shotcreting above ground shall not be carried out when, in the opinion of the Engineer, shotcrete cannot be placed effectively because of adverse weather conditions, unless adequate cover is provided over the working area until the shotcrete has been cured sufficiently to prevent damage.

(vii) When cold weather conditions prevail on Site and the temperature of aggregates and water to be used in Shotcrete is below 10°C, it may be necessary to heat the aggregate and water to obtain shotcrete meeting the specified 8 hours and 28 days compressive strength criteria. Heating of aggregates and/or water in excess of 27 °C shall not be permitted.

(viii) The contractor shall develop operating procedures and operations to the satisfaction of the Engineer to give:

(a) minimum rebound

(b) as smooth a finished surface as possible

(c) no hollow areas in the shotcrete

(d) a minimum of shrinkage cracks

(e) good adherence of the shotcrete to rock or other surface.

(ix) The flow of the material at the nozzle shall be continuous and uniform and the rate of application over any given area shall be uniform. Slugs, sand spots, wet areas or other defects shall be cut out and corrected as specified herein.

(x) At the start of shotcreting operations in any area, the contractor shall, in close co-operation with the Engineer and as part of the initial placement, establish procedures for the application of shotcrete which will produce the best quality product with the minimum of rebound. Such establishment of procedures shall include minor variations in Mixes, if required, and variations in acceptable finishes and thickness and quantities to be discharged at the nozzle to a unit area of rock or length of cavity as required by the Engineer. The quantities of shotcrete to be discharged at the nozzle shall be determined on the basis of average thickness of shotcrete shown on the drawings or as directed by the Engineer. Once procedures for the placement of shotcrete are established, subsequent Work shall be carried out accordingly.

(xi) The optimum distance between the nozzle and surface and the angle of nozzle shall be established by field trials to minimize rebound and achieve optimum compaction. The nozzle shall point to the surface at right angle to ensure optimal completion.

(xii) When required by the Engineer, the thickness of a layer in any area shall be checked by either probing immediately after the shotcrete has been applied, by placing pins of known lengths in the rock spaced at about 0.5 m to 1 m apart before shotcreting or by any other means approved by the Engineer.

(xiii) In shotcreting vertical or steeply inclined surfaces, other than roofs of underground cavities, application shall begin at the lowest point and the shotcrete layer shall be built up in horizontal strips until the entire surface is covered.

(xiv) In areas against which no further shotcrete is to be placed and where required by the Engineer, the edges of shotcrete shall be formed to regular lines and sloped at 45 degrees to the adjacent surface, all to the approval of the Engineer.

(xv) Where drain holes have been drilled and instruments have been installed into rock on which shotcrete is to be placed, the contractor shall take all necessary precautions to prevent such holes from being plugged or instruments from being damaged.

(xvi) When shotcreting is to be performed near existing structures, the contractor shall ensure that no damage results to the structures and shall protect the surface of structures before shotcreting.

(xvii) Application of shotcrete in any area shall be considered complete when the shotcrete has been built up to the thickness specified. The thickness of shotcrete specified on Drawings shall be the minimum thickness measured anywhere in the treated area, with the exception of protrusion of rock whose dimensions in plan are less than the thickness of the shotcrete specified, in

which case the minimum cover shall be not less than the 2/3 of the specified nominal thickness.

(xviii) Where shotcrete is placed over wiremesh and supporting bolts, it shall be covered with shotcrete to a depth of atleast 30 mm or as specified. Where rock bolt extensions are to be added to existing rock bolts, the exposed ends of the rock bolt threads shall be suitably protected before shotcreting.

(xix) While applying shotcrete, the nozzle shall be held steady at a predetermined distance from the surface to be covered and positioned so that the stream of flowing water and material shall be applied as nearly as possible at right angle to the surface to be covered. Nozzle shall be held in steady position so that the shotcrete is applied uniformly to build up the required thickness of layer. Acceptable shotcrete shall consist of dense and uniform concrete.

(xx) The nozzleman shall apply shotcrete with a uniform consistency in order to maximize binding, cohesion and density and minimize rebound and segregation, and prevent sagging of the applied shotcrete.

(xxi) Care shall be taken to ensure that no air pockets are formed behind shotcrete during its application.

(xxii) An approved method of establishing layer thickness, such as the use of plug gauges or boreholes, shall be employed.

(xxiii) Air used for spraying shotcrete shall be free from oil.

9.11 Steel fibre reinforced Shotcrete (SFRS)

9.11.1 Materials

(i) Material for Steel Fibre Reinforced Shotcrete (SFRS) shall comprise cement, aggregates, steel fibre, water and approved admixtures, micro-silica/silica-fume.

(ii) Cement shall be Ordinary Portland Cement (OPC) conforming IS-8112.

(iii) Aggregate shall conform to the requirement of Indian standard Code IS:383. The aggregate size shall not exceed 10 mm. The grain size distribution of aggregate shall be in accordance with the following table:

Sieve size	Percentage passing through the sieve	
mm	Minimum	Maximum
0.125	4	12
0.25	11	26
0.50	22	50

1.0	37	72
2.0	55	90
4.0	73	100
8.0	90	100
10.0	100	100

The aggregate shall be well graded and no fraction shall constitute more than 30% of the total. The contents of crushed and non cubical material should not exceed 10%. In case crushed materials are employed as part of aggregates, tests for comparison should be done to establish whether the addition of the crushed material gives an improved result.

9.11.2 Steel Fibres

The steel fibre to be used in SFRS shall be produced from high tensile steel, either cold rolled or cold drawn wires confirming to IS 432, Part-1 & 2 (latest edition). Fibres shall be dry and free from oil, grease and chlorides. The steel fibres shall satisfy the following parameters.

Length of steel fibres	25 mm to 40 mm (with 0.40mm dia.)
Geometric shape	The steel fibres shall have suitabally deformed profile to ensure proper matrix of SFRS mix and to develop better end anchorage with no fibre balling
Aspect Ratio (Length/equivalent Diameter)	45-75
Ultimate Fibre tensile strength	Not less than 1000 Mpa
Quantity of steel fibres	Not less than 50 kg/m^3 (Subject to mix design/field trials)
Shear Strength of steel fibres	8 to 10 MPa

9.11.3 Admixtures

Admixtures shall be used to develop quick set and high early strength, to ensure good workability, low pumping pressure, adequate slump retention and low rebound as approved by the Engineer, conforming to the requirements of the relevant Standards.

(a) Super Plasticizers

Super plasticizers/water reducing agents shall be added at the batching plant to keep the SFRS mix workable during transportation and to ensure good pumpability to an acceptable low water cement ratio. The super plasticizers shall be free of chlorides.

(b) Accelerators

A proven accelerator shall be added for providing a quick setting time. It shall be alkali free and shall be environment friendly. Only liquid accelerators shall be used to achieve low rebound and especially low fibre rebound.The accelerator shall have a pH value less than 3. The accelerators shall be added at the nozzle and doses shall be minimum but not exceeding 6% of the weight of cement.

(c) Micro-Silica or silica fume

Micro silica shall be added in the mix at the batching plant for facilitating the mixing and distribution of fibres .The dose of silica fumes shall 5 to 7% of cement weight subject to site trials. Silica fumes shall have a bulk density between 500-700 Kg/m^3.

Test certificates from approved & reputed testing laboratory shall be produced to satisfy that the silica fume complies with relevant International /Indian Standards.

9.11.4 Mix Design

(i) The contractor shall submit his mix design to meet the strength requirement specified as below for prior approval well before the commencement of SFRS application. The quantities of super plasticizers may be adjusted to compensate the slump loss because of steel fibres. The mix design shall provide the following details for one cubic meter of SFRS.

Ordinary Portland Cement		kg.
Aggregate:		
Natural fine aggregate	size	kg.
Natural coarse aggregate	size	kg.
Crushed fine aggregate	size	kg.

Crushed coarse aggregate		size	kg.
Steel Fibres	-------- Length------ (mm)	dia (mm)	kg.
Super plasticizers			kg.
Accelerator			kg.
Microsilica			kg.
W/C Ratio			
Slump			
Density (Wet)			

(ii) The SFRS shall meet the following Strength requirements:

a) Compressive strength on cylinderical cores

For 3 days,	Not less than 10 Mpa
For 7 days,	Not less than 18 Mpa
For 28 days,	Not less than 30 Mpa
b) Flexural Strength 28 days	Not less than 3.8 Mpa
c) Toughness 28 days	Not less than 2.4 Mpa

d) Bond strength

- Against intact rock 28 days — Not less than 0.5 Mpa
- Between two subsequent SFRS layers 28 days — Not less than 1.0 Mpa

(iii) Moisture content of the combined aggregate at the time of mixing with cement shall not exceed 6% (six per cent) by weight of the oven dry aggregate.

9.11.5 Method of application

(i) For the purpose of spraying SFRS, only wet mix method shall be used.

(ii) The Water Cement Ratio shall be 0.45 (maximum) by weight of cement plus microsilica.

(iii) The workability shall be measured by slump test which should be between 7 and 14 cm.

(iv) Prior to shotcreting, the rock surface shall be inspected and the thickness of SFRS to be applied shall be decided with the approval of Engineer.

(v) Surface shall be suitably prepared by scaling followed by cleaning with compressed air and water under pressure through nozzle. The cleaning shall start at the top arch and systematically go down on both sides. All surface shall be wet and clean at the time of applying SFRS.

(vi) When the mix arrives at site, the slump shall be recorded. The slump shall also be checked after interval of 15 minutes. The shotcrete older than 2 hours and having slump not within prescribed limits shall not be allowed to be used on the work.

(vii) Before starting, slurry shall be mixed and put into the concrete hose.

(viii) The application procedure of SFRS shall be developed in the field to give minimum rebound, minimum shrinkage etc.

(ix) Shotcreting shall always be started from the bottom to avoid rebound material getting locked in.

(x) The thickness of the first layer shall not exceed 50mm to avoid gliding of fresh concrete and subsequent layers of 25 mm- 50 mm as required.

(xi) Before laying the second layer of SFRS, the first layer shall be allowed to take its initial set and have all loose materials removed.

(xii) Care shall be taken to ensure that no air pockets are formed behind the SFRS during application of SFRS.

(xiii) All applied SFRS shall be kept wet for at least 7 days to ensure proper curing of the shotcrete.

(xiv) Sufficient air shall be added at the nozzle (minimum 12 m^3/min) to get good compaction and higher compressive strength

(xv) All necessary precaution shall be taken to ensure that there is no damage to the instruments installed in rock and that the drainage holes do not get plugged.

9.11.6 Test procedure

9.11.6.1 Testing of Fibres

The Steel Fibres shall meet the requirements given in ASTM A820-90. Important provisions of this Code are reproduced below:

Steel fibre requirements

(a) Length

The length shall not vary from its specified value by more that ±10%.

(b) Diameter

The diameter shall not vary from its specified value by more than ± 10%.

(c) Aspect Ratio

The aspect ratio shall not vary from its specified value by more than ±15%.

(d) Bending Requirement

Fibres shall withstand bending around 3.18 mm inside diameter to an angle of 90°C at temperature not less than 16 °C without breaking.

(e) Measurement of Dimensions

Measurement of dimensions shall be performed on not less than 10 randomly selected specimens for each test to establish the average for conforming to the specified tolerances. At least 90% of the specimens in each test shall meet the specified tolerances for length, diameter and aspect ratio. At least one test shall be performed for each 5 tonnes of material or each shipment, if less than 5 tonnes.

(f) Tensile Test

At least one tensile test consisting of 10 randomly selected finished fibres shall be performed for each 5 tonnes of material supplied or each shipment if less than 1.5 tonnes. The average value of these tests must not be less than the specified minimum.

9.11.6.2 Evaluation of Fibre Content

An evaluation of fibre content shall be carried out on a 5 kg specimen of fresh SFRS sampled from the works immediately after spraying. After washing out, the steel fibres shall be collected, dried and weighed. The weight shall be compared to the volume of the specimen which shall be determined as approved by the Engineer.

The frequency of testing for fibre content shall be one test, comprising of 3 specimens for each 200 m^3 of SFRS applied in the works.

9.11.6.3 Rejection and Retest

If any test fails to conform to the requirement, the material tested shall be rejected. When any test fails to meet the requirement of tension, bending or dimension tolerances, a retest shall be done. The retest shall be performed on twice the number of randomly selected specimens originally tested. The retest shall meet all the requirements, otherwise, the lot shall be rejected.

9.11.6.4 Certification

The contractor shall furnish a certificate from the manufacturer of Fibres that each lot has been sampled, tested and inspected in the accordance with this specification and has met the requirements. A report of the test results shall also be furnished.

9.11.7 Test for SFRS

9.11.7.1 Compressive strength

The equipment and procedure for compressive strength shall be in accordance with JSCE-SF5. The specimen cylindrical cores measuring 100mm/150mm as the case may be, in diameter shall be drilled out of the prepared test panels. Panels for testing shall be at least 600mm X 600 mm in size and shall be 200 mm thick. The panels shall be prepared by shotcreting into vertical moulds which shall be constructed of steel or other non-water absorbing rigid materials, and shall have sides splayed outwards at 45 degree to prevent the entrapment of rebound. Cores shall be tested for every 100m^3 of SFRS or as directed by Engineer.

9.11.7.2 Flexural Strength and toughness properties

Flexural strength and toughness properties shall be measured in accordance with Japanese standard JSCE-SF4. The beam shall be cut out from splayed panels. The beams shall be stored in water for a minimum of three days after sawing and immediately before testing and kept moist during testing.

9.11.7.3 Bond strength

(i) Testing of the bond strength between shotcrete and rock and between layers of shotcrete shall be carried out either in laboratory or insitu testing.

(ii) Tests shall be carried out on cores greater than 60 mm and less than or equal to 100mm in diameter. Drilling for in situ testing must penetrate the rock by at least 15 mm.

(iii) Cores taken for laboratory testing shall be cured and protected until the time of testing.

(iv) The rate of loading shall be greater than 1 MPa per minute and less than 3 MPa per minute.

(v) The frequency of bond testing shall be one test comprising of 6 specimens for each 300m^3 of SFRS or as directed by Engineer.

9.12 Rebound

(i) The rebound shall be removed and disposed off, as required by the Engineer before any adjacent area is shotcreted. Rebound shall not be reused. Special care shall be taken that rebound does not build up at the junction of walls and floors both underground and on the surface.

(ii) The contractor shall make every effort to keep rebound to a minimum. If in the opinion of the contractor, the rebound is excessive, he may request and submit revised mix design for the approval of the Engineer. The Engineer may also advice the contractor to submit revised mix design and/or application procedures so as to minimize the rebound. The approval by the Engineer of the mix design and/or the application procedures shall not relieve the contractor from his contractual obligations including but not be limited to taking of adequate measures to minimize the rebound and/or for the excess rebound. The quoted rates shall be deemed to include the wastage due to rebound of any magnitude and no additional compensation except payments at quoted rates shall be made.

9.13 Construction Joints

Construction joint or stop joints shall be provided, as directed by the Engineer and shall be sloped at 45 degrees to the adjacent shotcrete surface in a clean, regular edge. Before placing the adjoining Work, the sloped portion and adjacent shotcrete shall be prepared as specified in Para-9.9 hereof.

9.14 Repair

(i) Before a succeeding layer of shotcrete is placed, the preceding layer shall be checked for drumminess to the satisfaction of the Engineer.

(ii) The contractor shall repair all drummy, sandy, cracked or spalled areas and any other areas where, in the opinion of the Engineer, the shotcrete is faulty, by removing the shotcrete upto the sound area of rock or shotcrete, carrying out surface preparation as specified herein and re-shotcreting that area to the satisfaction of Engineer.

9.15 Safety Measures

(i) Alkali hydroxides and other chemicals contained in shotcrete admixtures are moderately toxic and can cause skin and respiratory irritation unless adequate safety measures are taken. In applying shotcrete containing toxic admixtures, the nozzleman and helpers shall wear appropriate hoods to protect them against toxic or objectionable material.

(ii) Gloves and necessary protective clothing shall be worn to protect against dermatitis.

9.16 Measurements and Payments

9.16.1 General

(i) Measurement for payment for shotcrete/SFRS will be of the volume of the shotcrete/SFRS applied. The volume will be calculated from the area of shotcrete applied on payline multiplied by the thickness as shown in construction drawings or directed by the Engineer.

An undulation factor as per actual tunnel profile will be worked out and applied. The theoretical quantity as on pay line will be multiplied by this undulation factor proposed to work out the quantities.

However, in case of approved overbreak, the actual pay line shall be taken into account. The undulation factor will be worked out at interval of 250m and shall be applied to the concerned section.

(ii) For various thicknesses of shotcrete/SFRS payment will be made at the Unit Rates entered in the Bill of Quantities, which shall include the entire cost of, but not be limited to, the following:

(a) All labour, plant and materials including cement, admixtures, steel fibre, micro silica etc. except steel wiremesh reinforcement.

(b) Storage, batching and mixing of all materials, water supply,

(c) Scaling, washing, preparation and cleaning of surfaces.

(d) Placing of plug gauges for control of layer's thickness.

(e) Placing of shotcrete/SFRS.

(f) Rebound and its removal.

(g) Temporary protection and curing.

(h) Making test panels, trial mixes and conducting tests.

(i) All types of admixtures/accelerators/super plastiezers.

(iii) The in-situ volume of Shotcrete/SFRS placed and measured for payment in underground works shall be deducted from the volume of structural concrete lining and backfill concrete to be measured for payment as stipulated in Chapter - Cement Concrete.

9.16.2 Materials

Measurement for payment and payment for steel wiremesh reinforcement will be made as stipulated for wiremesh in Chapter - Rockbolts and Wiremesh.

9.16.3 No Payment will be made for the following:

(i) Removing the defective shotcrete/SFRS, wasted shotcrete carrying out surface preparation and re-shotcreting the area where the shotcrete/SFRS has been found to be faulty by the Engineer.

(i) Any replacement or repair of shotcrete/SFRS damaged by blasting carried out by the contractor.

(ii) Taking out the cores from the finished shotcrete/SFRS and filling the core holes with dry pack mortar.

(iii) Shotcrete/SFRS placed by contractor in excess of thickness shown on the construction drawings or as specified by Engineer.

(iv) Rebound regardless of its magnitude.

(v) No separate payment will be made for the **cement,** admixtures, accelerator and super plasticisers or other additives as per requirement of design mix and the cost thereof shall be included in the Unit Price for shotcrete/SFRS.

(vi) Protection of exposed rock bolt threads prior to placement of shotcrete.

CHAPTER-10

STEEL REINFORCEMENT

INDEX

10.1 Scope of Work

The specifications described hereinunder are related to the Steel Reiforcement. This includes all labour, materials, equipment and services required for the supply, handling, storing, cutting, bending, cleaning, placing and fastening into position all reinforcing steel, as shown on the drawings, to be carried out by the contractor under this contract. The work shall further include the furnishing and installation of all tie wires, clips, supports, chairs, spacers and other appurtenances necessary to produce finished concrete structures.

10.2 Submittals

(i) Within 30 days from the date of issue of the Letter of acceptance, but before procuring or mobilizing to the Site, the equipment, the contractor shall submit to the Engineer, the description and drawings showing sufficient details of the layout, type and capacity of the equipment proposed for the fabrication of reinforcing steel.

(ii) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

(iii) During the progress of the work, Engineer will prepare reinforcement drawings which will indicate the main structural reinforcement required in the particular structure. The contractor shall notify in writing to Engineer at least 10 weeks before such drawings are required for each section of work. On the basis of these drawings the contractor shall prepare the detail bar bending schedules. All bars shown on the detail reinforcement drawings shall be identified on the bar lists and all bars shall be defined and dimensioned in clear and unambiguous way and be referenced to the relevant reinforcement drawings. The contractor shall be responsible for the correctness of the reinforcement drawings and bar lists. The contractor shall submit to the Engineer blue prints and transparencies of the reinforcement drawings and bar lists as stipulated in the conditions of contract.

10.3 Standards

(i) The cutting, welding, placement and binding of reinforcing steel shall conform to following latest Indian Standards or, where not covered by these Standards, to their equivalent International Standards (latest edition)

IS:432(Part-1) Specifications for mild steel and medium tensile steel bars and hard drawn steel bars for concrete reinforcement.

IS:456 Code of Practice for Plain & Reinforced concrete.

IS:1786 Specification for high strength deformed steel bars and wires for Concrete reinforcement.

IS:2502	Code of practice for Bending and fixing of Bars for concrete reinforcement.
IS:2751	Code of Practice for welding of mild steel Plain & Deformed Bars for Reinforced concrete construction.
IS:13920	Code of practice for Ductile detailing of reinforced concrete structures.

(ii) In case of conflict between the above standards and the specifications given herein, the Specifications shall take precedence.

10.4 General

(i) Steel for reinforcement shall conform to the Standards and requirements outlined under Para-3.3 (i) (c) of Chapter-Material for Construction of these documents.

(ii) Cutting, bending, cleaning, placing and fastening in position of the reinforcement steel shall conform to the requirements of relevant Indian Standards and as shown on the drawings.

(iii) Transportation and storage of reinforcing steel shall conform to the requirements outlined in Chapter-III of these documents.

(iv) Steel for reinforcement of specified quality shall be procured from the sources/plants approved by the Engineer.

(v) Testing shall be conducted as per the requirements of Indian Standards given in 10.3 above.

(vi) Before starting concreting, the contractor shall make sure that the measurements of reinforcing bars placed in position have been recorded and that the Engineer has certified the correctness of the reinforcement used.

10.5 Storage

(i) Reinforcing steel shall be stored above the ground in separate groups according to size and length. Reinforcing steel which has been cut and bent according to the schedules approved by Engineer shall be marked with a bar number shown on the schedule, by using weatherproof tag or by placing in marked bins, and shall be stored in such a manner as to be readily accessible when required and to facilitate inspection.

(ii) Reinforcement fabric supplied in rolls shall be straightened into flat sheets before being placed.

10.6 Fabrication

(i) All bars shall be cut and bent in accordance with the bar bending schedules approved by the Engineer.

(ii) Reinforcing steel bars shall be cut and bent on the site of the works or at a fabricator's plant. Notwithstanding the above, a bar-bending machine and a representative stock of reinforcing steel shall be maintained on the site, sufficient to allow minor revisions and additions to be carried out as required by the Engineer.

(iii) Reinforcing steel shall not be straightened or rebent in a manner that will damage the materials. Bars with kinks or bends other than those indicated on the drawings and schedules shall not be used.

(iv) Shorter lengths of steel shall not be used in places where continuous lengths are required as per the drawings without the approval of the Engineer. Shorter bars, if approved for use, shall be lapped or spliced to achieve continuity in accordance with the requirements of relevant Indian Standards or as approved by the Engineer.

(v) Bars shall be bent cold to the shape and dimensions shown on the drawings using a bar bender operated by hand or power to attain the proper radii of bends.

(vi) Heating of reinforcement bars to facilitate bending shall not be permitted.

(vii) The reinforcement available from rejected reinforced concrete shall not be used without prior approval of the Engineer.

10.7 Placing

(i) Before being placed in position, the reinforcing steel shall be thoroughly cleaned of loose mill scale and rust, grease, paint, or other coatings that would reduce bond. All splashed concrete which has dried on reinforcing steel shall be removed.

(ii) Reinforcing steel to be incorporated in the Works shall be placed accurately in positions as shown on the drawings and shall be held firmly in place during the placing and setting of the concrete.

(iii) Reinforcing steel shall be so placed that there will be a clear distance of at least 50 mm between the reinforcing steel and anchor bolts or embedded metal Work, if not shown otherwise on the drawing or required otherwiswe by Engineer.

(iv) Reinforcing steel shall be maintained in position by the use of small concrete blocks, steel chairs, steel spacers, steel hangers and other steel supports and ties, acceptable to the Engineer at sufficiently close intervals so that they do not either sag between supports or be displaced during placing of concrete or by any operation on the Work. Wood supports or spreaders shall not be used. All

intersections shall be securely tied except that where the bar spacing is less than 300 mm in each direction, only alternate intersections need be tied.

(v) Binding wire and steel chairs shall not be carried to permanently exposed surfaces and shall be subject to the same requirements with regard to concrete cover as for the reinforcing steel.

(vi) Special care shall be exercised to prevent any disturbances of the reinforcement in concrete that has already been placed. The reinforcement after being placed in position shall be maintained in a clean condition until it is completely embedded in concrete.

(vii) The longitudinal bars shall be straight and fixed parallel to each other and to the sides of the form as shown on the drawings. The ties, links and stirrups connected to the bars shall be tightly fixed so that the bars are properly braced. The inside of their curved part shall be in actual contact with the bars around which they are fixed and their position shall be exact as shown on the drawings.

Wire for tying reinforcement shall be black annealed iron wire. The diameter of wire shall not be less than 1.6 mm and shall have an ultimate strength of 5.63 t/cm^2 and yield point of not less than 3.87 t/cm^2.

(viii) Reinforcement for lining in underground cavities and other locations may be fixed in position by means of anchor rods or supporting and hanger rods as approved by the Engineer. In difficult locations, tack welding of bars at isolated spots may be permitted to keep these bars in position.

(ix) The steel bars shall be joined by providing lap joints in accordance with the requirement of the relevant Indian Standards or as approved by the Engineer. “Bar-Grip” type joints may also be adopted by the contractor for deformed bars of 25 mm diameter and above, subject to the approval of the Engineer. Splices at points of maximum stress shall however, be avoided. Splices in adjacent bars shall be staggered as directed by the Engineer. Lap length of bars shall be as shown on the drawings. This length may be changed by the Engineer in special locations.

(x) Sufficient concrete coverage, as indicated on the drawings shall be provided to protect reinforcement from corrosion. All protruding bars from concrete to which other bars are to be attached and which shall be exposed to action of the weather for long period shall be protected from rusting by a thin coat of neat cement grout. Accurate record shall be kept at all the times of the number, sizes, lengths and weights of bars placed in position for different parts of the Work.

(xi) Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original positions, care shall be taken to ensure that at no time is the radius of the bend less than 4 bar diameter for plain mild steel or 6 bar diameter for deformed bars. Care shall also be taken when bending back bars, to ensure that the concrete around the bar is not damaged.

(xii) The cover of the reinforcement shall be as shown on the construction drawings.

(xiii) All reinforcement shall be inspected in place and approved by the Engineer before placing the concrete. Concrete placed in violation of this provision may be rejected and removal required.

(xiv) The **couplers** shall be used for splicing the reinforcing bars of 32 mm diameter and more as indicated in the construction drawings or as directed by the Engineer.

10.8 Welding for Reinforcement bars

(i) Lap splices shall not be used for bars larger than 36 mm diameter, which may be welded with the approval of the Engineer. In case where welding is not practicable, lapping of bars larger than 36 mm diameter may be permitted, in which case, additional spirals shall be provided around the lapped bars. Where welding is approved, the contractor shall prepare at least three samples of buttwelds as directed by the Engineer. These specimens shall be got tested by the contractor in recognized laboratory. If the results are satisfactory, the Engineer may allow welding in place of lap joints. The decision of the Engineer in this regard shall be final. The joint shall be butt welded by the electric-arc-method. The ends of the bars shall be cleaned of all loose scale, rust, grease, or other foreign materials and all welding shall conform to the relevant standard specifications for welding of reinforcement bars used in reinforced concrete construction or as directed by the Engineer.

(ii) A weld shall be considered unsatisfactory if it fails to sustain a tensile stress of at least 90% of the tensile strength of the bar in which the weld has been made.

10.9 Tolerance for Placing Reinforcing Steel

Unless otherwise specified by the Engineer or shown on the drawings, reinforcement shall be placed within the following tolerances:

a) Protective cover:

For cover up to 50 mm	$\pm$ 6 mm
For cover 75 mm and more	$\pm$ 12 mm or 1/3rd of specified cover whichever is less

b) Spacing:

For effective depth 200 mm or less	$\pm$ 10 mm
For effective depth between 200 and 2000 mm	$\pm$ 15 mm
For effective depth more than 2000 mm	$\pm$ 25 mm

10.10 Measurements and Payments

(i) Measurement for payment for reinforcing bars will be of the weight of reinforcement steel including hooks, bends, coupler and splices actually installed and approved by the Engineer. Actual lengths of reinforcement bars including permissible hooks, bends and splices will be measured. Devices like steel chairs, hangers, spacers, other supports, ties and anchor rods etc. used to maintain reinforcing steel in position will also be measured for payment. The weight of reinforcing bars will then be calculated for each size of bars from the Unit weight as specified in the relevant IS codes.

(ii) For the purpose of payment, a welded joint will be considered as equivalent to a length of bar 30 times the diameter of the bar in which the weld is made and will be paid at the rate of reinforcement steel entered in the Bill of Quantity.

(iii) Payment of steel reinforcement will be made at the Unit Rate per MT entered in the Bill of Quantities, which shall include the entire cost of supply, handling, storage, cutting, bending, placing, wire clips,coupler and any other fastening devices..

10.11 No measurement for payment or payment will be made for the following:

(a) Wire for tying reinforcement.

(b) Reinforcement and prestressing steel in precast and precast-prestressed concrete units, and the cost thereof shall be included in the applicable Unit Rates for such concrete elements.

(c) Any additional reinforcement or splices required when contractor's casting sequences differ from construction joints shown on the drawings.

(d) Any reinforcing steel placed by the contractor for his own convenience in addition to those shown on the drawings.

(e) Any reinforcing steel delivered for testing.

(f) Carrying out tests for checking butt welds to replace lapping/splicing of reinforcing bars.

(g) Scrap or wasted steel (the scrap generated from the cutting and binding of the steel shall become contractor's property)

CHAPTER-11

FORMWORK

INDEX

11.1 Scope of Work

The specifications described herein-under relate to the form work. This work shall include all labour, plant and materials, and services related to the design, fabrication, supply, erection, maintenance and removal of formwork and falsework to be carried out by the contractor under this contract.

The formwork shall be fabricated and erected to the dimensions of finished surfaces of concrete as shown on the drawings or as otherwise directed by the Engineer.

11.2 Submittals

(i) At least 120 days prior to the construction of telescopic steel formwork for the tunnel, surge shaft or multijunction lining as also the formwork for other concrete works, the contractor shall submit, to the Engineer, the following:

a) Shop drawings (4 copies), details and structural computations (2 copies) of the formwork construction.

b) Details of materials which the contractor intends to use for the fabrication of formwork, surface finishes, and construction techniques which the contractor proposes to use in order to achieve the required concrete surfaces and allowable tolerances,

c) Source of arrangement of equipments required like Traveler, hydraulic jacker etc.

(ii) Review by Engineer of contractor's drawing and calculations shall not relieve contractor of its responsibility for the adequacy of form and falsework, or for the safety of persons or property, for the successful completion of the work.

(iii) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

11.3 General

(i) Forms or formwork shall mean the mould into which concrete is placed.

(ii) Falsework or shoring shall mean the structural supports and bracing for forms used in any part of the works.

(iii) All exposed concrete surfaces having slopes of 1.5:1 or steeper, shall be formed unless otherwise directed.

(iv) Where the character of the natural material cut in, to receive concrete is such that it can be trimmed to the prescribed lines, the use of forms shall not be required.

(v) Type of Finish, application and tolerance shall be as per Chapter-Cement Concrete.

11.4 Materials

(i) Forms shall be of timber, steel or other approved material, except that the sheeting for all exposed surfaces, where form lining is not specified shall, be of tongue and groove timber of uniform width unless otherwise directed by the Engineer.

(ii) All materials used in formwork construction shall be of adequate strength and quality for their intended purpose and shall be satisfactory to the Engineer.

(iii) Timber shall be sound, straight, free from warp, decay and loose knots, and shall be dressed smooth.

(iv) Where plywood is used, it shall be non-warping, non-wrinkling and manufactured with special water-proof glues. Plywood sheets shall be of uniform width and length.

(v) The surface of steel or steel lined forms shall be smooth. Forms with dents, buckled areas or other surface irregularities shall not be used.

(vi) Reuse of forms and form lumber shall be allowed only if they are thoroughly cleaned and repaired and capable of producing the finish required for the concrete. Timber or plywood forms, repaired with metal patches, shall not be used unless permitted by the Engineer.

(vii) Damaged forms or forms which have deteriorated through usage shall not be used.

(viii) Form oil used on surfaces of timber or plywood forms shall be a straight, paraffin base refined, pale, mineral oil. The oil used on the surface of steel forms shall be specially compounded petroleum oil and other oils of animal or vegetable origin and gums or resins which are heavier in body and frequently darker than straight petroleum oils shall be used in the case of steel lining forms. The contractor may use any other material also for coating of the formwork with the approval of the Engineer.

(ix) Forms of like character shall be used for similar exposed surface in order to produce a uniform appearance.

(x) The type, size, shape, quality and strength of all materials from which forms are made, shall be the sole responsibility of the contractor but subject to the approval of the Engineer.

(xi) In general, forms for permanently exposed surfaces shall consists of or shall be lined with matched or dressed edge grain timber of appropriate thickness, free from loose or cracked knots.

(xii) Metal forms or metal-lined forms shall be permitted for permanently exposed surfaces only when an entire surface is to be built completely with such forms.

(xiii) Forms for concrete surfaces exposed to flowing water (other than tunnel lining) shall be lined with sanded, uncoated, plywood veneer. Steel or impermeable plastic liners will not be permitted.

11.5 Design, fabrication, Erection and Maintenance of Formwork

(i) Forms and falsework shall be designed, fabricated, erected and removed in accordance with the applicable provisions of the recommended practice for concrete formwork of IS:456(latest revision), as required by the Engineer and as specified herein.

(ii) All false work shall be designed to withstand safely all live and dead loads, necessary pressures, ramming and vibrations without significant deflection from the prescribed lines, which might be applied to the false work during all stages of construction, service and removal.

(iii) The contractor shall be solely responsible for the design, construction and maintenance of all formwork and false work required in the work.

(iv) Detailed drawings of shoring and false work shall be prepared by the contractor. The calculations and drawings shall show the size and specification of the false work, including the type and grade of all materials used in the construction, design loads on false work supports, horizontal forces imposed on the false work and used for design purpose, and details of splices and connections, including nails, spikes and other fasteners. If mechanical equipment such as concrete buggies screening machines, etc., are to be used, this information shall be shown on the drawings.

(v) Falsework shall be constructed only after the falsework drawings have been approved by the Engineer.

(vi) The approval by the Engineer of contractor's drawings shall not relieve the contractor of his responsibility for the adequacy of form and falsework, or for the safety of persons, property, or for the successful completion of the work.

(vii) The contractor shall construct the falsework strictly in accordance with the approved falsework drawings, one set of which shall be kept on the site at all times, and no changes shall be allowed without prior written acceptance of such changes by the Engineer.

(viii) Forms shall be designed to permit the concrete to be deposited, as closely as is practicable directly in its final position, and to allow inspection, checking and clean up of the formwork and reinforcement to be completed without delay.

(ix) Formwork and falsework shall be designed, constructed, erected and maintained such as to confine the concrete without loss of mortar and produce finished surface which are within the tolerances specified.

(x) Forms for concrete against which backfill is to be placed or which shall not be exposed to view may be constructed of smooth tight boards not less than 25mm nominal thickness.

(xi) Forms for concrete exposed to flow of water or exposed to view shall be constructed of steel or plywood which is smooth and free from defects with matched and sanded joints to give a symmetrical pattern over the entire area. Chamfer strips, 40mm by 40mm, shall be used on all exposed corners, unless otherwise specified or required by the Engineer.

(xii) Form ties, supports, anchors, braces, spreaders and other similar devices which shall be embedded in the concrete for holding the forms shall incorporate threaded metal bars to facilitate removal of forms. Wood spreaders shall not be left in the forms. Any metal remaining embedded in the concrete shall be at least 50mm from the surface of concrete. Holes left in the concrete by removal of parts of form ties or similar devices shall be well filled with cement mortar and neatly finished to match the adjacent concrete.

(xiii) Form inserts or other similar permanently embedded items shall be accurately located and securely fastened in place. The number and location of form ties and bolts shall be such as to ensure that forms fit tightly against the concrete previously placed and remain in tight contact during operations.

(xiv) Forms shall be set and maintained within the specified tolerance limits such that the complete concrete surfaces are within these limits.

(xv) All form surfaces shall be thoroughly cleaned before erection and shall be lubricated with a non-staining mineral oil. All excess oil shall be wiped off the forms prior to placement of concrete. Oil shall not be allowed to come into contact with reinforcing steel or other embedded items. For use of timber forms, the oil shall be capable of penetrating the timber and keeping it sufficiently oily to eliminate sticking and preventing absorption of water and consequent warping.

(xvi) The oils shall be applied by brush, spray or swab and the forms shall be covered fully and evenly without excess or drip. Care shall be taken to prevent oil from getting in the surface of construction joints. Special care shall be taken to oil thoroughly the form strips for narrow groove seats, windows, doors and elsewhere so as to prevent swelling of the forms and consequent damage to concrete prior to the removal of forms.

(xvii) Immediately before concrete is placed, all forms shall be inspected to ensure that they are properly placed, sufficiently rigid, clean, tight and properly surface treated and free from encrustations of mortar, grout or other foreign materials.

No concrete shall be placed until formwork has been inspected and accepted by the Engineer. Where forms of continuous surfaces are placed in successive units, the forms shall fit tightly over the surface so as to prevent leakage of mortar from the concrete and to maintain accurate alignment of the surface.

(xviii) The formwork for the gate groove areas shall be accurately drilled to be held with first stage anchor couplings/plates to be embedded in primary concrete. Both shall be fixed through formwork into the first stage anchors coupling/plates to ensure that the couplings/plates remain flush with primary concrete face and the couplings do not get plugged.

(xix) Where timber forms are used, the laying shall be in the direction which will blend architecturally into the lines of the structures, as decided by the Engineer.

(xx) Curved and special forms shall be such that these will result in smooth concrete surfaces. They shall be designed and constructed so that they will not warp or spring up during erection or placing concrete.

(xxi) When metal sheets are used for lining forms, the sheets shall be placed and maintained on the form with the minimum amount of wrinkles, humps or other imperfections. The use of sheet metal to cover imperfections in the lining of timber faced forms for surfaces that shall be permanently exposed to view, shall not be permitted.

(xxii) Where plywood or hardboard is used for form lining, the joints between the sheets shall be smooth and as perfect as practicable and no patching of the plywood or hardboard shall be permitted for permanently exposed surfaces. Minor imperfections in the plywood may be corrected by the use of plastic wood secured firmly in place and sand papered smooth.

(xxiii) Wire ties shall be permitted for the forms when specially approved by the Engineer and shall be cut off flush with the surface of concrete, after the forms are removed. Wire ties shall not be used when permanently exposed finished surfaces are required.

(xxiv) Forms shall be so constructed that the finished concrete surfaces shall be of uniform texture in accordance with the type of finish specified for concrete surfaces in these specifications.

(xxv) The erection of formwork in position shall be rapid enough, rigid and strong to withstand concreting operations and maintain the alignment. Panels of similar shape shall be identical and inter-changeable.

(xxvi) For special sections/shapes, timber/steel form shall be used, as approved by the Engineer.

(xxvii) The contractor shall strengthen or modify the formwork, whenever required by the Engineer.

(xxviii) Unless authorized, suitable mouldings shall be placed to level all exposed edges, at construction joints, and any other edges shown on the drawings, or as required by the Engineer. The final detailed drawings shall show any formed recesses, slots, blockouts and similar construction details, which have to be taken into account in fixing the formwork.

(xxix) Forms shall be maintained, at all times, in good condition, particularly as to size, shape, strength, rigidity, tightness and smoothness of surface.

(xxx) The Engineer will, at any time, have the right to reject formwork which he considers to be no longer fit for use.

11.6 Formwork for Tunnel and Caverns

(i) Formworks for final concrete of overt portion of the tunnel , shaft & arch portion of the underground caverns shall, in general, consist of an approved movable type of telescopic and or collapsible steel shuttering of robust design manufactured in adequate lengths or heights.

(ii) Forms to be used for sides of caverns shall be of a design approved by the Engineer consistent with these specifications and surface finish etc. The forms shall be capable of easy manipulation (hydraulic or mechanical) and of accurate setting and shall be made in suitable segments. The segments shall be properly shaped and stiffened to ensure proper matching with adjacent segments.

(iii) The forms shall be fitted with ample windows at appropriate spacing and locations to allow the introduction of vibrators and to carry out inspections and any other work needed behind the form.

(iv) The formwork shall be of rigid construction, non-deformable due to working loads imposed upon it. Once installed in the position, the form shall remain in position without displacement during concrete placement.

(v) The formwork shall be constructed in such a way that no abrupt irregularities arise at vertical construction joints. The joint in formwork shall overlap the vertical construction joint by at least 50 cm.

(vi) The windows shall be provided in each side about the mid height at the tunnel and the crown on alternate sides of the centerline. The windows shall be at least 60cm in the least dimension and shall be spaced at a distance not exceeding 2.5m.

11.7 Removal of Formwork

(i) Forms shall not be removed until the concrete has hardened and has attained a crushing strength of at least twice the stress which the concrete may be subjected to at the time of removal of forms.

(ii) Duration for which the forms shall remain in place shall be decided by the Engineer, with reference to weather conditions, shape, position of the structure or structural members and the nature and magnitude of dead and live loads. The forms shall not be removed without the permission of the Engineer.

(iii) The following minimum intervals of time shall generally, be allowed between completion of placing of concrete and removal of forms but the period shall be increased in case of wet or cold weather and as directed by the Engineer.

	Structure	**Period in days for Ordinary Portland Cement***
a)	Beam sides, walls, columns (unloaded)	3
b)	Sides and props to slabs	
	• Spanning upto 4.5m	7
	• Spanning over 4.5m	14
c)	Beam soffits (Props left under)	8
d)	Props to beams and arches	21
e)	Mass concrete	2
f)	Tunnel lining	½

Note:-**For other cements, the stripping time recommended above may be suitably modified after approval of Engineer.*

The above minimum periods are only recommendatory. The contractor, may, where he so desires, extend the above to longer intervals. This shall not, however, constitute any reason for any claim for extension of time or damage to concrete etc.

(iv) If the contractor desires to remove the forms earlier than the period stated above by addition of cement and/or suitable admixtures in the concrete, so as to gain early strength without affecting long term strengths, the matter shall be examined by the Engineer in each case and his decision in the matter shall be final and binding.

(v) Heavy live loads shall not be permitted until after the concrete has reached its design strength.

(vi) The forms shall be removed with great caution and without jarring the structure and avoid throwing heavy forms upon the floor. In order to achieve this end, wedges and clamps shall be used whenever practicable instead of nails.

(vii) In order to avoid excessive stresses in the concrete that might result from swelling of the forms, wood forms for wall opening shall be loosened as soon as this can be accomplished without damage to the concrete. Forms for the openings shall be constructed so as to facilitate such loosening.

(viii) The contractor shall be solely responsible for any damage that may be caused by negligence, lack of proper precautions or hastiness etc. in the matter of removal of forms and shall make the same good to the satisfaction of the Engineer.

11.8 Measurement and Payments

(i) Measurement for payment for formwork will be of the formed area for the class of formwork as shown on the drawings or as directed by the Engineer.

(ii) Measurement for payment for formwork used to form contraction and expansion joints will be made of the plain area in square meters of joints shown for key boxes shown on the drawings or as directed by the Engineer.

(iii) Payment will be made at the Unit Rates per m^2 entered in the Bill of Quantities for various classes of plain and curved formwork, which shall include the entire cost of provision, maintenance, oiling, erection, all necessary ties and fixing, access scaffoldings, forming of chamfers upto 500mm^2 either internal or external and edges upto 50mm width.

(iv) Openings in the forms for blockouts, niches, etc., of area smaller than 0.05 m^2 will not be deducted from the area measured for payment.

11.8.1 No measurement for payment or payments will be made for the following:

a) Any kind of construction joints

b) Steel formwork used for tunnel, surge shaft or multijunction lining or any other underground/surface concrete where the rate is inclusive of form work.

c) Formwork used for manufacturing of precast and precast-prestressed concrete units.

d) Bulk head.

e) Unformed surfaces

f) Any forms rejected by the Engineer and replacement thereof.

g) Additional cement and/or admixture which the contractor adds to concrete to gain early strength to facilitate removal of formwork earlier than the specified period.

h) Any damage caused by contractor's negligence during removal of formwork.

i) Any damage caused owing to the periods, as specified under para 11.7 hereof, for removal of formwork not being sufficient. The cost thereof shall be included in the applicable Unit Rate for concrete in the structure with which it is associated.

CHAPTER – 12

DRILLING AND GROUTING

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12.1 Scope of work

(i) The specifications described herein under relate to the work of drilling and grouting, which includes all labour, materials, equipment, accessories and operations required for the performance of drilling grout holes and exploratory holes, washing and water pressure testing of grout holes and supplying, transporting, storing, mixing and injecting grout materials and additives for consolidation and curtain grouting including void filling/contact grouting within the underground construction sites and from surface, at locations shown on the drawings or where directed by the Engineer.

(ii) Cement Grouting Operations shall include the following:

(a) Contact grouting, at pressures up to 5 bar between the steel liner and concrete in pressure shaft and surge shaft:

- To fill voids between concrete and rock.
- In the concrete plugs in the tunnels.

(b) Consolidation grouting, at pressures upto 30 bar, of the rock surrounding the excavated hollow space, which shall commence after placing of the concrete lining and completion of contact grouting.

(c) Consolidation grouting in the heading zone during excavation, at pressures up to 50 bar, to consolidate the heading face before further advance in zones of sheared and disturbed material and / or in zones of high water inflow.

(d) Fill grouting, at pressures upto 5 bar, of drainage trench, conduits and sump pits, and of exploratory drill holes and drain holes.

(e) Crack grouting, at pressures up to 5 bar, to seal open cracks and joints in the structural concrete lining.

(f) Chemical grouting in zones of fine sands and soils, and to control the water inflow and increase the stability and strength of the formation that are too tight to be grouted with a cement grout.

(iii) The general extent and approximate location of the drill holes for the contact and consolidation grouting are tentatively indicated on the bid drawings. The final number, length, location and inclination of drill holes, as well as the composition and consistency of the grout mixes, grouting pressures, pumping rates and sequence in which the holes are to be drilled and grouted shall be governed by actual conditions encountered on site and shall be at all times subject to approval by the Engineer and shall be accordingly executed by the contractor.

(iv) The entire temporary drainage shall be filled with grout.

(v) The extent of crack grouting will be determined by the Engineer.

(vi) The extent and location of chemical grouting will be determined by the Engineer.

12.2 Submittals

(i) At least 30 days prior to the start of grouting works, the contractor shall submit, to the Engineer for approval, detailed proposals and a detailed layout of his proposed arrangements for drilling and grouting, including specifications of all equipment, tools and all grouting materials to be used, and qualification and experience of the proposed personnel.

(ii) An overall drilling and grouting programme shall be drawn up jointly between the contractor and the Engineer. Grouting mixes, pressures, pumping rates, and sequencing will be selected, subject to modifications, to meet local conditions encountered during the performance of the work. Grouting works shall be planned in such a manner that they can be carried out according to the approved plan concurrently with other activities.

(iii) Prior to each phase of grouting, the contractor shall submit, to the Engineer for approval, a detailed programme for the particular grouting works alongwith information relating to the methods he proposes to use and details of grout mixes. No grouting work shall be executed without the prior written approval by the Engineer.

(iv) During the performance of the grouting works, the contractor shall keep complete daily records of all grouting operations which shall include the following:

(a) Number and location of the drill holes.

(b) Results of water-pressure tests

(c) Grouting method.

(d) Date and time of commencement and of each change in grouting operations.

(e) Rate of pumping.

(f) Grouting pressures and gauge reference number.

(g) Water-cement ratio and its variations.

(h) Quantities of cement, sand, bentonite, flyash, admixtures and chemicals used.

(i) Connections, if any, with other holes and cracks, as well as any surface leakage of water or grout. Location, how caulked and the success of caulking shall be described.

(j) Number of holes and depth of holes left for redrilling.

(k) Time of completion.

(l) Name of the foreman in-charge.

Grouting reports in an approved form shall be compiled from these records and submitted weekly to the Engineer. Results of water pressure tests and grout intakes shall be presented graphically.

(v) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

12.3 Standards

(i) Materials for grouting and performance of grouting work shall conform to the following latest Indian Standards or where not covered by these standards, to the equivalent International Standards:

IS:8112	Specification for 43 grade OPC
IS :12269	Ordinary Portland Cement, 53 Grade
IS:1489	Specification for Portland Pozzolana Cement
IS:383	Specification for Coarse and Fine Aggregates from natural source for concrete
IS:5878 (Part – VII)	Code of Practice for construction of Tunnels conveying water: Part7 - Grouting
IS:9103	Concrete Admixuters- Specifications
IS:6066	Pressure grouting of Rock Foundations in River Valley Projects Recommendations.
IS :2720	Methods of Tests for soils (Part1 to Part 41)
IS : 12584	Bentonite for Grouting in Civil Engineering Works.

(ii) In cases of conflict between the above Standards and the Specifications given herein, these specifications shall take precedence.

12.4 Definitions

12.4.1 Cement Grout

(i) Cement grout is defined as a mixture of cement and water with the addition of admixtures, sand and bentonite, if required, which is forced under pressure into prepared holes or pipes in order to fill voids or consolidate the rock mass as a whole.

(ii) Cement grouts are subdivided into stable and unstable mixtures:

(a) Unstable mixtures are simple suspensions of cement in water. These suspensions are only homogeneous as long as they are in movement and the sedimentation starts as soon as the movement is stopped.

(b) Stable mixtures are colloidal suspension dissolved in water of which grain size is so small that no appreciable sedimentation occurs during the grouting operation.

These suspensions are obtained by high-speed mixing of cement with addition of bentonite.

12.4.2 Chemical Grout

(i) Chemical grout is defined as a mixture of two or more solutions which combine chemically and form a gel or a solid matter. The solutions may react either prior to pumping into, or within the void.

(ii) The chemicals may be used in combination with cement or clay grouts as determined by testing and approved by the Engineer.

12.4.3 Single-Stage Grouting

The single-stage grouting is carried out by introducing the grout at either the collar of the hole through a nipple or by means of a grout supply pipe at the bottom of the hole. The entire length of the hole is grouted in one operation.

12.4.4 Multiple-Stage Grouting

(i) Multiple-stage grouting is carried out by introducing the grout into a predetermined section of the hole which is blocked off by a packer. The grouting of the entire length of hole is performed in successive stages either in ascending or descending arrangement.

(ii) The terms ascending or descending arrangement mean only the sequence of the grouting stages, either from bottom to the collar of the hole or in reverse, irrespective of the effective direction of inclination of the hole.

(iii) When grouting is done in ascending arrangement, the hole is drilled to its full depth, washed out, and the packer is set at the top of the deepest section to be grouted. The section is then water-pressure tested and grouted at the required pressure through the grout supply pipe. The packer is allowed to remain in place until there is no back pressure and then withdrawn to the top of the next section to be grouted. The water-pressure testing and grouting is repeated successively, section by section, until the entire length of the hole is filled with grout.

(iv) When grouting is done in descending arrangement, the work is accomplished in sections from the collar of the hole. The hole is drilled to a limited depth, washed out and the packer is set just above the section to be grouted. The section is then water-pressure tested and grouted at the required pressure. The grout within the hole is removed before it takes a hard set while the grout in the rock surrounding the hole is allowed to obtain its initial set, before the hole is drilled to an additional depth. Repeating thus successively drilling, water-pressure testing, and grouting at various depths until the entire length of hole is completely drilled and grouted.

12.4.5 Water Cement Ratio

The water-cement ratio (W/C) is the proportion by weight of water to cement in a water-cement mixture.

12.5 General

(i) During drilling, grouting, washing and pressure testing operations, the contractor shall keep concrete and rock surfaces free and clean of oil, grease, drill cuttings, grout, cement, excess of water or any kind of waste. At all times during the progress of work pertaining to this item, contractor shall protect all open drill holes from becoming plugged or filled with oil, grease, drill cuttings, grout or waste. The contractor shall clean-up and remove all waste in each area on completion of the work.

(ii) Before starting the grouting, the contractor shall give due notice thereof to the Engineer, to enable him to be present during the grouting operations, which shall always be done in his presence.

(iii) The grout mix that might flow out or otherwise get spilled on the concrete lined surface shall be removed expeditiously without allowing any time for the grout to set on the concrete surface.

(iv) After finishing of grouting, each grout hole shall be redrilled to 2/3rd of theoretical lining thickness and filled with dry pack mortar.

12.6 Sampling and Testing

(i) The contractor shall provide samples of materials and prepare trial mixes as directed by the Engineer and shall hand over the same to the Engineer for testing at least 30 days before the commencement of any grouting. The materials for use in grout mixes shall be tested with applicable requirements stipulated in these specifications.

(ii) The Engineer shall carry out the following tests:-

(a) Laboratory Tests.

- Grain size distribution and moisture content of sand, and bentonite, including aerometer analysis.
- Atterberg limits
- Chemical analysis of water and solids
- Compressive strength
- Viscosity (by fan-viscosimeter and Marsh cone)
- Density
- Decantation and setting time (by Vicat needle)
- Shrinkage of grout

(b) Field Tests

- Density by hydrometer or mud balance
- Viscosity by Marsh cone

(iii) All chemical grouts shall be tested jointly by contractor and Employer under conditions identical to those to which they will be subjected in the field, in order to determine the suitability of various chemicals and proportion of the ingredients to satisfactorily complete the work.

(iv) During the actual grouting operations, the Engineer will carry out tests on grout mixes at the same time as grouting, and will plot values of viscosity, sedimentation limits, compressive strength, and maximum viscosity possible for the grouting on a diagram. The frequency of testing will be once for each grouting jobsite or until acceptance criteria have been met. However, if a significant change in the cement source occurs, sampling and testing shall be repeated.

12.7 Grouting Materials

12.7.1 General

(i) The following kinds of grout mixes may be used:

(a) Neat cement grout, possibly with admixture.

(b) Cement-sand grout, possibly with admixture.

(c) Chemical grout such as polyurethans, one or two component type.

(d) Cement-bentonite grout with or without sand

The quantities of sand, bentonite, and admixture will depend on the permeability of the rock and the size of the voids to be grouted.

(ii) Cement, sand and water for use in grout mixes shall conform to the requirements of Chapter-Material for Construction and relevant standards except as specifically amended here-in-after.

12.7.2 Cement

(i) The cement shall conform to relevant Standards and shall be free from lumps. Any cement containing lumps and foreign matter detrimental to the results of grouting shall be rejected by the Engineer.

(ii) The contractor shall handle, store and protect all cement and admixture in such a manner that these materials will not be subject to deterioration or contamination. Deteriorated or contaminated materials shall not be used in the Works.

12.7.3 Sand

(i) Sand in grout might be required for small portions of the work in highly fissured or fractured rock zones. Sand shall contain fines conforming as per relevant IS code as approved by the Engineer.

(ii) Sand shall not contain more than 3% of flat or elongated particles having a maximum dimension in excess of four times the minimum dimension.

12.7.4 Water

(i) The water for grout mixtures should be clean and generally free from organic material that would affect hardening or durability. A sample should be tested to determine if the water contains any deleterious materials.

(ii) Water shall not contain more than 2 parts per thousand of suspended colloidal solids and no particles larger in size than the cement particles. The chloride content shall be less than 50 mg/l and the sulphate content less than 100 mg/l.

(iii) The temperature of water used for the preparation of grout shall not exceed 25°C.

12.7.5 Admixture

(i) Admixture shall be added to grout mixes to optimize the strength, viscosity, density, decantation, setting time and shrinkage.

(ii) Only admixtures proved suitable by testing prior to the start for grouting shall be used. Manufacturer's certificates or guarantees will not be accepted as relieving the contractor of his responsibility for the suitability of any admixture.

12.7.6 Bentonite

Bentonite shall conform to IS: 12584 and shall have a plasticity index greater than 400%. Bentonite contained in a solution of water shall have no particles exceeding 0.08 mm. The bentonite shall be of high grade quality as classified under table 1 of IS: 12584. Cumulative percentage by weight of all particles finer than 0.002 mm shall be greater than 85% when tested for fineness by wet sieving in accordance with IS: 2720 (latest revision).

The contractor shall submit the technical data sheet of the selected bentonite to Engineer for review, with among other the hydration rate and the bulking capacity in water (expanding capacity depending on water content).

12.7.7 Polyurethans

(i) Polyurethans shall be used for consolidation of the sheared or disturbed rock, loose material, and for impermeabilization against water inflow even under high pressure.

(ii) Polyurethans shall be of acceptable quality as approved by the Engineer.

12.7.8 Other Chemicals

(i) When other chemicals are required or proposed, they shall be accompanied by the manufacturer's certificates that they have been commercially used with satisfactory service in the similar type of work. The storage, handling and usage shall be strictly with the manufacture's printed instructions.

(ii) The use of toxic chemicals such as acrylamide shall not be permitted for use in the works.

12.8 Grout Mixtures

(i) The type of grout and the products for each mixture will be determined by the Engineer according to design requirements and the purpose of the work.

(ii) The proportions of various constituents in the grout mixtures shall be selected by the Engineer in collaboration with the contractor and shall be constantly adopted to the conditions on the site as the Engineer may direct.

(iii) The contractor shall be required to prepare and inject the following grout mixes:

- (a) Cement/ sand mix with admixture for contact and fill grouting.
- (b) Cement / water mix, possibly with addition of bentonite, for consolidation grouting after placing of concrete lining.
- (c) Polyurethans or cement / water mix with admixture for grouting in the heading zone during excavation.
- (d) Cement/water mix with admixture, possibly with addition of polyurethans for crack grouting.

(iv) Any grout mixture not used within one hour after mixing shall be rejected.

12.9 Drilling and Grouting Equipment

12.9.1 General

(i) Only modern, properly operating drilling and grouting equipment approved by the Engineer and operated by trained and experienced crew shall be used for the performance of the Work. This shall be specifically observed when dealing with chemical products.

(ii) Standard drilling equipment of the rotary or percussion type shall be used to perform the drilling as specified herein and as required by the Engineer. Drills shall be capable of drilling grout holes 38 mm minimum and 45 mm minimum

for consolidation and curtain grouting respectively in diameter to a maximum depth of 60 m at any inclination. Percussion type drilling equipment shall be equipped for continuous washing of holes during drilling..

(iii) Standard diamond drilling equipment shall be used to perform the drilling of exploratory holes. Drills shall be capable of drilling and retrieving core 38mm minimum in diameter to a maximum depth of 60m at any inclination. Core retrieval shall be accomplished by a triple-tube core barrel.

(iv) The Engineer may require some of the grout holes and pressure relief holes to be drilled using rotary type drills with core recovery. The rotary type machines shall be capable of drilling NX size holes utilising double/ triple tube core barrels equivalent and capable of recovering soft or friable materials with maximum possible core recovery. The equipment and crew shall be made available at site when Engineer requires exploratory holes to be drilled. All such cores shall be properly stored in wooden boxes and logged for inspection as per the Indian Standard.

(v) The drilling units shall be mobile and of size suitable to the dimensions of the galleries.

(vi) The contractor shall keep at the site an ample supply of different types and sizes of drilling bits to allow optimal drilling in the different materials to be encountered in the course of work, and sufficient rods and casings of various diameters to allow proper telescoping and to ensure the stability of drillholes.

(vii) The contractor shall provide measuring equipment for checking the actual inclination and alignment of drill holes.

(viii) The washing and water pressure testing plant shall include pumps, guages, valves and all other accessories necessary to complete the Works as specified. The pumps shall be of the gear, centrifugal or other acceptable types and shall be capable of maintaining constant pressure. The contractor shall supply water storage tanks sufficient for the pumps in addition to flow meters and pressure guages for calibration and checking purposes.

(ix) Grouting equipment shall consist of grout pumps, weighing scale for additives and cement, grout mixers, water meters, agitator sumps, pressure guages, packers, pipe lines and fittings and miscellaneous tools, and shall be specifically designed for grouting purposes.

(x) Water meters shall be calibrated in litres and tenths of liters without by pass so that water can be measured directly in the mixer. A strainer with cleaning valve shall be provided in the water supply line, upstream of the meter to prevent sand and abrasive particles from entering the meters.

(xi) Grouting equipment shall be capable of effectively mixing and stirring the grout and forcing it into the grout holes or grout connections in a continuous, uninterrupted flow at any specified pressure up to maximum of 50 bars, accurately measuring the grout intake, and maintaining the specified pressure for at least 5 minutes after the hole refuses to accept further grout. The equipment shall be capable of accurately controlling grout flows and

pressures and shall be suitable for neat cement, cement-sand, and chemical grouts.

(xii) Spare gauges, valves and fittings shall kept available on the Site, and a two way communication system between the mixing plant and place of grouting shall be provided if the distance exceeds 60m.

(xiii) Standby equipment which can be activated immediately shall be available to ensure continuity of work in the event of main equipment breakdown. The standby equipment shall be able to operate at pressures up to 20 bar.

(xiv) Prior to commencement of the work, during the work as specified or as required by the Engineer, and at the end of the work, all pressure gauges, recorders and discharge meters shall be checked and calibrated.

(xv) Grouting headers shall be provided for feeding grout into the holes. The header shall include a supply connection, a connection with a valve to the hole, and a return line with valve. Two number of approved make pressure gauges for the appropriate pressure range shall be installed. One shall be installed to indicate the pressure of the supply at the pump and the other to measure the back pressure at the hole.

(xvi) Contractor shall furnish, install, maintain and operate satisfactory communication system between grout plants and the holes being grouted regardless of grout area locations.

(xvii) Contractor shall supply sufficient operating personnel, supervisors, labour, spare tools, to carry out each phase of the work properly and expeditiously.

(xviii) The grouting units shall be mobile and of size suitable to the dimensions of the galleries/drifts.

(xix) The grouting equipment shall always be maintained to the satisfaction of the Engineer in order to guarantee continued and efficient performance during grouting work.

12.9.2 Grout Mixers and Agitator sumps

(i) Grout Mixes for mixing the stable mixtures shall be of the mechanically operated, high speed colloidal type of sufficient size, and operating at 1,500 to 2,000 rpm with electric or pneumatic drive to ensure complete dispersion and activation of the mix.

(ii) Grout mixers shall have a minimum capacity of 0.5 m^3 and shall be mechanically operated horizontal paddle type or preferably colloidal high speed impeller type. Facilities shall be provided at the mixer for the accurate measurement of grout materials so that mix proportions can be carefully controlled.

(iii) Sump or holding tanks having a minimum capacity of 0.5 m^3 shall be mechanically operated and designed to keep the mixed grout agitated and in suspension. All grout should be discharged from the mixer into the agitator

and from the agitator into the pump panel through a 2.36 mm screen to remove lumps and large particles.

(iv) For mixing the unstable mixtures, the paddle mixers may be used.

(v) Hand-powered mixers or concrete mixers shall not be permitted for preparation of grout mixtures.

(vi) Mixer shall be provided with equipment for measuring weight and volume of mix components with an accuracy of 2% and a water meter calibrated in litres with a reset switch for zeroing after each delivery.

(vii) After mixing, the grout shall be discharged through a 5 mm mesh screen into an agitator sump equipped with stirring paddle to prevent settling and to remove any air bubbles from the mix. The stirring paddle shall be of such arrangement to guarantee a complete circulation of the entire sump content. The agitator sump shall have at least the same capacity as the mixer so that one batch of grout can be pumped while the next batch is being mixed.

12.9.3 Grout Pump

(i) The grout pumps shall be capable of delivering a flow upto 50 litres per min. of thick grout (W/C =1) at specified pressure and shall be able to achieve and hold a pressure up to 50 bar at the delivery point.

(ii) Pumps shall be of duplex double acting piston-type, or a single acting plunger type, or other type approved by the Engineer. The pump body shall be of high wear and shock resistant material. The plunger unit shall be of stainless steel, highly resistant to abrasion.

(iii) The pump shall have either pneumatic drive or electro-hydraulic drive.

(iv) The pumps shall be equipped with precise pressure and capacity control valves which allow the setting of both, the maximum pressure and the flow independently. The pump shall automatically stop whenever the preset pressure is reached, and shall maintain the pressure without fluctuation.

(v) For works requiring a small volume of grout such as crack grouting or rock bolts grouting, the contractor may use hand operated grout pumps approved by the Engineer. These pumps shall be able to achieve a pressure of up to 30 bar.

12.9.4 Pressure Gauges

(i) The contractor shall provide pressure gauges for both low and high pressure ranges (0-15 bar and 0-50 bar). Two gauges shall be provided in each grout line, one at the pump for the use of the pump operator, the other at the hook up connection directly at the collar of the hole. The required pressure for each particular hole shall be measure on the hook up pressure gauge, not at the pump.

(ii) Pressure gauges shall have an accuracy of 3%. A minimum of two standardized pressure gauges for each range shall be calibrated and certified by an Independent laboratory prior to the commencement of grouting works. One gauge shall remain at the disposal of the Engineer, and the other shall be used by the contractor for checking and calibration of working gauges. Working gauges shall be used for no longer than 2 shifts before being cleaned and recalibrated. All working gauges shall have reference numbers for identification which shall be quoted in the grouting reports to be submitted to the Engineer.

12.9.5 Connections to Grout Holes and Packers

(i) Supply and return lines equipped with quick release couplings shall be able to withstand an internal pressure greater than the maximum produced by the pump. The internal diameter of the lines shall be such that no appreciable settlement of grout takes place when pumping at the minimum discharge capacity of the pump.

(ii) Valves shall be provided at the pump, in the supply line and at the collar of the hole being grouted. Suitable screens shall be incorporated in the supply line for removing oversize particles and foreign matter before injection into the grout hole.

(iii) Packers shall be the same as used for water pressure testing and shall be of the mechanical rubbing ring or pneumatically expandable rubber types. These shall be capable of sealing holes without leakage. These packers shall be capable of being used either single or double. Double packers shall be separated by upto 3m of perforated pipe. The diameter of pipes used for separating and placing the packers in holes shall be the maximum possible for the size of the holes.

12.9.6 Embedded pipes and Fittings for Grouting

(i) Standard mild steel pipes and fittings for grouting shall be set in the rock and concrete as directed by Engineer or where shown on the drawings. The pipes and fittings embedded in concrete shall be cleaned thoroughly of all dirt, grease, grout and mortar immediately before embedment and shall be firmly held in position and protected from damage or displacement while the concrete is being placed. The size of the pipes embedded in concrete lining for drilling holes for grouting shall be 50mm in internal diameter or as shown on the drawings. A standard coupling and nipple wrapped to facilitate eventual removal, shall be attached to the grout pipe where embedded in concrete. No portion of the pipe shall be allowed to remain within 50mm of the concrete surface and the resulting recess, after removal of the pipe or fitting, shall be filled with dry-pack mortar.

(ii) Care shall be taken to avoid premature blockage of pipes. Any pipe that becomes blocked before completion of operations shall be cleaned in a satisfactory manner or replaced by the contractor.

12.10 Drilling of Holes

(i) The number of holes to be drilled, their location, sequence, orientation, inclination and the depths shall be as shown on the drawings, or as directed by the Engineer.

(ii) All holes shall be established within 0.25m of the specified location.
Maximum deviation angle for drilling the drainage hole shall be 5 degrees.

(iii) Installation of 50mm dia PVC pipes with perforation and wrapping with Geotextile.

(iv) The holes drilled in the slope around the excavated face shall be fitted with polyvinyl chloride (PVC) pipe with perforated holes. These PVC pipes shall be filled with gravel. Steel strainer shall be provided on the outlet of the pipe.

(v) The drill holes shall conform to following table:

Internal Bar Diameter	Drillhole Diameter
25mm	38mm
32mm	48mm
36mm	54mm
48mm	72mm

Note:- In case contractor's available equipment cannot drill hole of required diameter and it has to drill hole of higher diameter subject to approval of Engineer, the payment to contractor shall be limited to the diameter specified in these Specifications or construction drawings.

12.10.1 Drilling of Holes for Draining of Rock

(i) The contractor shall drill holes around the periphery of the excavation for draining the surrounding rock. The minimum diameter of holes shall be 38mm or as shown on the drawings or as directed by the Engineer.

(ii) When so directed by the Engineer, these holes shall be used for consolidation grouting of the surrounding rock to check the leakage of water.

(iii) The holes drilled in the roof of the cavern / tunnel arch shall be fitted with galvanized iron pipes extending from the ceiling of the arch to the vertical walls of the cavern / tunnel as directed by the Engineer. These galvanized iron pipes with manifolds shall later be covered by shotcrete.

12.10.2 Drilling of Holes for Grouting, Exploration and Instrumentation etc.

(i) Grout holes shall be drilled either directly into the rock or through the concrete lining and then into rock as directed by the Engineer.

(ii) The holes shall be drilled in a direction normal to the surface of the underground excavation / concrete lining as the case may be. In cases where seams, if any, in the rock have to be intersected, the holes shall be drilled at inclinations as directed by the Engineer.

(iii) While drilling the holes, utmost care shall be taken to ensure that the reinforcement or structural ribs, if any, in the concrete lining shall not be cut through. The position of steel ribs shall be recorded and marked on the finished concrete lining. If the reinforcement or steel ribs are encountered during drilling of any hole in concrete, drilling shall be discontinued immediately and a new hole shall be drilled nearby. The holes so abandoned shall be backfilled with concrete as directed by the Engineer and the surface of concrete shall be repaired.

(iv) Each hole shall be protected from becoming clogged or obstructed by a grout connection pipe fixed suitably into the holes and the holes shall be suitably capped or otherwise protected until these are grouted. Any hole that becomes obstructed before being grouted shall be cleaned out in a satisfactory manner.

(v) Generally, the holes for consolidation, curtain or contact grouting and pressure relief shall be drilled with the percussion type drill which shall be equipped for constant water flushing at the far end of the drill rod.

(vi) The use of rod dope, grease or other lubricants on drill rods shall not be permitted and no drilling water additives or any kind shall be used without the approval of the Engineer.

(vii) All holes for consolidation and contact grouting shall be 38 mm minimum in diameter whereas holes for curtain grouting shall be minimum 45 mm in diameter. Pressure relief holes and the exploratory holes shall be 76 mm minimum in diameter.

(viii) Whenever the drill water is lost or artesian flow is encountered, drilling operations shall be stopped and the hole shall be grouted before drilling operations are resumed. The contractor shall record the location, flow and the pressure of any artesian conditions encountered in any drill hole.

(ix) On completion of drilling and washing of any grout or pressure relief holes, the contractor shall immediately cap the holes with proper removable plugs (wooden or plastic) and shall protect them from entry of dirt or other foreign material. Any grout or pressure relief hole, that gets obstructed prior to grouting or installation of elbow, shall be cleaned out or another hole shall be drilled.

(x) Grout or pressure relief holes shall not be drilled within 12m of another hole which is being grouted or which has been grouted within the previous 24 hours.

(xi) No hole shall be drilled through concrete before 5 days after the placement of the concrete.

(xii) Exploratory drill holes, from which cores shall be obtained, shall be required to determine the condition of the rock before grouting or after grouting, to test the effectiveness of the grouting operations. Logging of cores will be done by the Engineer.

(xiii) The contractor shall provide securely nailed wooden core boxes, acceptable to Engineer. The contractor shall place the cores in the boxes in correct sequence, segregated accurately by labelled wooden blocks according to the measured distances in the holes. No box shall contain core from more than one hole. Designated marks, hole numbers and elevations shall be placed on the end of the boxes and along the line of core. The covers shall be fastened securely to the core boxes, and the boxes shall be delivered to Engineer's laboratory on the site.

(xiv) Exploratory holes shall be water pressure tested in stages, as specified herein, and grouted to full depth.

12.11 Washing of Holes

On completion of drilling, all drill holes shall be thoroughly washed (as explained in IS:6066-1984) to remove any accumulation of fines, sludge, or foreign materials, Holes shall be washed out by water injected through a wash pipe at the bottom of the holes until clear water returns. contractor shall continue flushing for two minutes after the return water becomes clear. For grout holes, washing will also be required immediately before water testing and grouting.

12.12 Grouting Operations

12.12.1 General

(i) All pressure grouting operations shall be performed in the presence of the Engineer.

(ii) In the Underground Works, the Grouting works and other operations shall be carried out in the following sequence, unless otherwise directed by the Engineer.

(a) Consolidation grouting and impermeabilization of the rock ahead and around the heading face as needed, before further advance.

(b) Fill grouting exploratory and drain holes, which may be required during underground excavation, prior to placing of concrete lining.

(c) Contact grouting in the crown of the tunnel and cavern after placing of concrete lining.

(d) Fill grouting of drainage conduits and sump pits.

(e) Consolidation grouting of rock surrounding the excavated space. Depending on the rock conditions, the Engineer may direct to carry out this grouting in two stages, first at low pressure of 10-15 bars, and the second upto 30 bars.

(f) Control grouting.

(g) Installation of one-way check valves.

(h) Crack grouting as directed.

(iii) The above sequence is not exhaustive and the contractor shall plan his operations in such a way that he is flexible to adapt to the conditions encountered.

(iv) The utmost care and precautions shall be taken to ensure that the concrete does not get damaged during the grouting operations.

(v) If the Engineer considers necessary to carry out an additional grouting in any section of the works, the contractor shall reinstall the necessary equipment and perform the grouting to the satisfaction of the Engineer.

12.12.2 Contact Grouting

12.12.2.1 Contact Grouting between Concrete and Rock

(i) Low pressure contact grouting shall be carried out between concrete and rock over the entire length of the tunnel and cavern to fill voids between the rock surface and the following:

(a) Structural concrete in the crown of the tunnel and cavern and in the concrete plug in the tunnels.

(b) Concrete in any other zone within the Underground works were conditions so require and as the Engineer may direct.

(ii) Contact grouting shall normally be performed from holes drilled in the crown of the tunnel and cavern, and shall be carried out in advance of consolidation grouting operation.

(iii) Contact grouting in the completed concrete plug in access adits shall be performed through the pipe system cast into the body of the plug as specified in chapter “Cement Concrete”.

(iv) Water pressure testing will not be required prior to contact grouting.

(v) In any section of the underground structure, the concrete lining within 100m of that section shall have been in place for at least 21 days before grouting commences.

(vi) Contact grouting shall be carried out at low pressure (not exceeding 5 bar) using a cement-sand grout and shall continue until all voids are filled. Vent pipes for the release of air and water during grouting shall be provided in locations directed or approved by the Engineer.

(vii) After the grouting of any hole is completed, the pressure shall be maintained, by means of a stopcock or other suitable device, until the grout has set.

(viii) Contact grouting shall be carried out, where directed by the Engineer, to verify that voids have been completely filled with grout. Grouting will be regarded as being satisfactory if the pressure can be maintained for at least 5 minutes without further grout intake.

12.12.2.2 Contact Grouting between Backfill Concrete/Concrete and Steel Lining

(i) Grouting between the steel lining and the backfill concrete/ concrete in any section of tunnel or shaft shall not commence until the backfill concrete within 100m of that section has been in place for at least 28 days.

(ii) Low pressure contact grouting shall be carried out until all voids between the steel lining and backfill concrete are thoroughly filled. The maximum grouting pressure shall be 3 bar or as directed by the Engineer. A special air chamber and safety valve shall be incorporated into the grouting system to smooth out pressure fluctuations and limit maximum pressure.

(iii) Only stable, cement-water mixture with addition of plastifying agent shall be used for this grouting.

(iv) Pre-tapped holes for grouting complete with threaded steel plugs, shall be provided in the steel lining. The contractor shall provide threaded pipes to protect the thread of the grouting hole during the drilling and grouting operation, as shown on the drawings.

(v) After completion of grouting, the contractor shall wash and clean the threaded holes and screw the plugs back into position. The plugs shall be welded permanently into the steel lining and stub heads ground off flush. When this work is complete, the contractor shall thoroughly clean the whole steel lining surface of all grout remnants and other debris.

(vi) After completion of the grouting, the Engineer and the contractor will inspect together the effectiveness of the grouting. Should a hollow sound indicate voids, the contractor shall open additional holes and inject grout until all voids are completely filled.

(vii) Caution shall be exercised by the contractor during the grouting operations to prevent any damages to already applied corrosion protection of the steel lining.

12.12.3 Fill Grouting

(i) Fill grouting of exploratory and drain holes shall be carried out before placing of the concrete lining.

(ii) After completion of contact grouting, the entire system of temporary invert drains and sump pits in the tunnel and cavern shall be filled by grouting with a cement-sand grout at a pressure up to 5 bars.

(iii) The contractor shall use a systematic procedure for fill grouting of the invert drains and sump pits to ensure displacement of water and complete filling of the drains and pits.

12.12.4 Consolidation Grouting

(i) Consolidation grouting of the rock surrounding the excavated hollow space shall be carried out in sections of the underground structures as directed by the Engineer. Consolidation grouting may also be directed by the Engineer during the excavation works in order to consolidate the heading face or seal of the inflow of groundwater.

(ii) Consolidation grouting shall normally be performed in a single stage through a nipple or packer installed at the collar of the hole within the concrete lining, but if geological conditions so dictate, multiple-stage grouting either in ascending or descending arrangement shall be performed in particular holes. The grouting pressure for each stage shall be determined by the Engineer.

(iii) Grouting for rock consolidation in any section of the completed underground structures shall not start earlier than 21 days after the completion of the contact grouting within 100 m of that section. Consolidation grouting at an open air structure shall first commence 7 days after concrete placement.

(iv) Grout shall normally consist of a water-cement slurry (W/C = 0.7) with admixtures and possible with bentonite, as directed by the Engineer. Grout to seal off the inflow of groundwater may include also a filler or a chemical to be approved by the Engineer. Unless specifically otherwise directed by the Engineer, the grouting pressure shall not exceed 30bars.

(v) Immediately before grouting, the grout holes shall, rock characteristics permitting, be thoroughly washed out under pressure, until the returning water is clear, and then as the Engineer may direct, pressure tested.

(vi) Where, during grouting of any hole, grout is found to be flowing from adjacent holes or cracks of any kind, such openings shall be capped temporarily by plugging or caulking.

(vii) When performing the multiple-stage grouting in descending arrangement, the grout that is within the hole shall be removed from each stage except the deepest one, by washing, or by the use of chopping or a “fishtail” bit before it takes a hard set.

(viii) Grouting of a hole will be considered to be complete when the rate of grout intake at the maximum grouting pressure is less than one Bag of 50 kg. (by weight) 0.03 m^3 of grout mixture per 10 minutes.

(ix) After completion of grouting, the packers shall remain in the hole and the pressure shall be maintained until the grout has attained its initial set.

(x) The results of water-pressure testing and all information obtained during the performance of grouting will be used for the determination whether the grouting in each section of the works under consideration is completed in a satisfactory manner, or whether additional grouting in separate drill holes is required. The termination of grouting work in any sequence in any section of the works will be decided by the Engineer.

12.12.5 Closure of Holes and Clean-up

(i) Upon completion of grouting work, each hole shall be filled with thick grout and connections not embedded in the concrete shall be removed. The drilled holes in the concrete lining shall be reamed or redrilled to a depth corresponding to the 2/3 of theoretical concrete lining thickness and filled with dry-pack mortar, as stipulated in “Repair of Concrete” in Chapter - Cement Concrete, flush with the concrete surface. In the steel lined sections, the holes shall be closed as described here-in-above in “contract grouting between Backfill concrete and steel lining”.

(ii) After completion of the grouting works the internal surface of the concrete or steel lining shall be cleaned and restored to its original condition.

12.12.6 Crack Grouting

(i) Crack grouting shall be performed to seal the cold joints, construction joints, shrinkage cracks, honeycombs, poorly closed grout holes etc., in the structural concrete linings of underground structures as directed by the Engineer and as stipulated in chapter - Cement concrete.

(ii) Crack grouting shall consist of injecting a stable, cement-water mix with admixture through holes specially drilled into cracks or joints. Preventive measures shall be taken by plugging the joint with wooden wedges, cardboard, cement-gypsum mortar or other suitable means to prevent the grout from flowing out of the crack.

12.12.7 Curtain grouting

(i) Curtain grouting shall not be started until consolidation grouting has been completed within 60 m radius around the curtain holes to be grouted.

(ii) Primary holes shall be drilled, washed, subjected to water pressure testing, when required by the Engineer, and grouted before proceedings to execute

the secondary holes. The depth of holes and spacing between them shall be as shown on the drawings or as directed by the Engineer.

(iii) Unless otherwise specified by the Engineer, curtain grouting shall be done in stages of 5 m each.

(iv) If grout absorption in any 5 meter stage, which is not caused by leakage at the surface, is found to be excessive in adjacent primary and secondary holes, the Engineer may require the contractor to drill and grout additional

holes between the primary and secondary holes.

(v) Unless otherwise directed, air, wash water, and grout pressures shall not exceed 2 bar plus 0.25 bar per linear meter of the depth measured from the collar of the hole to the bottom of the packer. In no cases shall grouting result in heave or hydrofracturing (sudden increase of take). Grout pressure shall not be released nor packers moved until the grout in each successive stage has achieved an initial set.

(vi) The curtain grouting shall be performed from one or several grout stations. If several such stations are used, each shall be equipped complete, with mixers, agitator sumps, pumps, gages and measuring devices, and shall have a sufficient supply of grouting materials.

(vii) In case when the required pressure is not reached even when injecting maximum volume, the Engineer will decide whether the grouting will be interrupted, or the grout mixture is to be changed, or accelerator added.

(viii) Where grout is found to be flowing from adjacent holes or cracks of any kind, such openings shall be capped temporarily by plugging or caulking. If this does not bring satisfactory results, further grouting shall be interrupted and the injected material allowed to harden.

(ix) Grouting injection will be deemed to be completed when the intake has become 0.03 m^3 or less per stage of hole being grouted during 10 minutes at the specified grouting pressure and mixture.

(xi) After the conclusion of the grouting program, the contractor shall drill inclined check holes. Unless otherwise directed, the check holes shall be drilled at the spacing of 30 m, and two-thirds the depth of the grout curtain. Check holes may also be drilled in areas of complex hydrogeology, which require particular treatment. These holes shall be filled with grout. Based on the results obtained in the check holes, the Engineer may order additional grout holes or a new line of grout holes to be executed.

12.12.8 Pre-grouting

(i) Poor ground condition in underground excavation may require, ahead of face stabilization/ support using pre-grouting.

(ii) Pre-grouting shall consist of drilling of 38mm dia. holes (up to 10 m long) at an inclination of 5 to 10 degrees outgoing along the periphery at an approximate spacing of 1.5 m. These holes shall be grouted using a neat

cement grout mix with w/c ratio varying from 0.8 to 0.4; bentonite shall be added as necessary and as directed by the Engineer.

12.12.9 Water Pressure Testing

(i) Water pressure tests with double packer apparatus having a perforated pipe not less than 1.5m shall be carried out on the grout holes identified by the Engineer. The actual spacing will be determined by the Engineer. Water pressure shall then be applied to the test section for a minimum period of 5 minutes.

(ii) The maximum pressure for water testing shall correspond to the pressure specified for grouting. Water loss shall be measured in litres.

(iv) Based on the results of the water pressure tests, the Engineer may require additional grouting. Such grouting shall be carried out by the contractor at the pressure specified by the Engineer.

12.12.10 Grouting of Overburden below foundations

(i) The riverbed overburden below the foundations shall be grouted which mainly consists of gravel, boulder and porous material; so that permeability tests shall not yield permeability values greater than 3 Lugeons at a pressure of 10 bars, failing which additional grouting shall be carried out as directed by the Engineer.

(ii) Drilling (min. 100 mm dia) shall be done by ODEX/ Down- The- Hole Hammer with Special Bits method as described in IS:4999 and as approved by the Engineer.

(iii) Grouting shall be done through tubes and sleeves system as described in IS:4999.

(iv) The grout material and mix shall be determined by the Engineer in accordance with the guidelines of IS:4999

12.13 Measurements and Payments

12.13.1 General

(i) The estimates of the quantities for grouting given in the Bill of Quantities are to be considered as merely a guide and not as an accurate indication of the quantities of the Work.

(ii) Measurement for payment and payment for drilling of holes will be made at the appropriate Unit Rates entered in the Bill of Quantities.

(iii) Measurement for payment and payment for ODEX/ Down- The- Hole Hammer with Special Bits drilling method shall be made at the appropriate Unit Rates per linear length (meters) as entered in the Bill of Quantities.

(iv) The quantities for each pay item will be varied to suit the conditions disclosed in the course of the work. The Unit Rates for drilling holes shall include, but not be limited to, the entire cost of labour, equipment, materials and washing and cleaning of holes.

(v) Measurement for payment and payment will be made separately for placing grout and for grouting materials used as entered in the Bill of Quantities with exception for contact grouting in the crown of the tunnel, shaft and cavern, either concrete or steel lined.

(vi) Measurement for payment and payment for grouting in overburden grouted using pipe and sleeve method below foundations shall be at Unit Rates per hole entered in the Bill of Quantities, which shall include, but not be limited to, the entire cost of labour, equipment, processing, sheath grouting, mixing, hooking-up to the hole, injecting grout, hole closures and clearing up and shall be independent of the volume or weight of materials injected.

(vii) The cost of cement, bentonite and sand shall be paid separately as per the unit price entered in the Bill of Quantities.

(viii) Measurement for payment and payment for supply and installation of PVC pipes(±50 mm dia) to be placed in drill holes (min. 100 mm dia) for grouting in overburden below foundations having perforations of 4 holes drilled on cylindrical surface at regular spacing of 50 cm c/c covered by a rubber sealing including provision of connection socket between different pipe segments and all accessories like bottom pipe cap etc complete in all respect including coupling will be made at Unit Rates per meter of relevant items entered in the Bill of Quantities.

(ix) Measurement for payment and payment for water pressure testing will be made at Unit Rates entered in the Bill of Quantities.

(x) Measurement for payment and payment for supply and installation of PVC pipes with perforations and wrapping with textiles perforated PVC pipes including coupling will be made at Unit Rates per meter of relevant items entered in the Bill of Quantities.

(xi) Units Rates for placing grout shall include, but not be limited to, the entire cost of labour, equipment, processing, mixing, hooking-up to the hole, injecting grout, hole closures and clearing up and shall be independent of the volume or weight of materials injected.

(xii) Unit Rates for grouting materials used shall include, but not be limited to, the entire cost of supply, handling, transportation, storage, and complying with all requirements specified.

(xiii) Unit Rates for placing grout shall also include the cost of furnishing samples of grouting materials and providing assistance for sampling required in connection with the tests to be performed by the Employer.

12.13.2 Placing Grout

12.13.2.1 Contact Grouting

(i) Measurement for payment for placing grout between backfill concrete and steel lining will be of the number of holes injected with grout. Payment will be made at the Unit Rate per hole entered in the Bill of Quantities, which shall

include the supply of threaded plugs to protect the thread of the grout holes in the steel lining.

(ii) No measurement for payment or payment will be made for placing grout between the rock surface and structural concrete in the crown of the tunnel and cavern. The cost thereof shall be included in the appropriate Unit Rates for concrete.

(iii) When contact grouting has been ordered by the Engineer for backfilling the voids created by approved geological overbreak, or in any other zones except the crown, the measurement for payment will be of the number of holes injected with grout. Payment will be made at the Unit Rates per hole entered in the Bill of Quantities.

12.13.2.2 Fill Grouting

(i) Measurement for payment for filling the temporary drainage system in the Underground works with grout will be of the length of the drainage system in which fill grouting has been completed to the satisfaction of the Engineer. Payment will be made at the Unit Rate per linear meter entered in the Bill of Quantities, which shall include the provision of any standpipes, blockouts or extra drilling work required.

(ii) Measurement for payment for fill grouting of exploratory holes, where directed by the Engineer, will be of the number of holes so grouted. Payment will be made at the Unit Rate per hole entered in the Bill of Quantities.

12.13.2.3 Consolidation Grouting

(i) Separate measurement for payment and payment will be made for placing grout in holes:

(a) In single-stage grouting

(b) In multiple-stage grouting

(ii) Measurement for payment for placing grout in a single stage grouting will be of the number of holes injected with grout. Payment will be made at the Unit Rate per hole entered in the Bill of Quantities.

(iii) Measurement for payment for placing grout in multiple stage grouting will be of the number of holes injected with grout. Payment will be made at the Unit Rate per hole entered in the Bill of Quantities. These Unit Rates shall apply regardless of whether the grouting is carried out in the holes drilled from the surface or from the underground.

12.13.2.4 Curtain Grouting

Measurement for payment for placing grout will be of the number of holes injected with grout. Payment will be made at the Unit Rate per hole entered in the Bill of Quantities. These Unit Rates shall apply regardless of whether the grouting is carried out in the holes drilled from the surface or from the underground.

12.13.2.5 Crack Grouting

No extra measurement for payment or payment will be made for crack grouting and the cost thereof shall be included in the unit Rates for structural concrete lining.

12.13.2.6 Pre-grouting

Payment for pre-grouting in tunnels shall be made as under

a) Drilling of hole of 38 mm dia per meter length of hole

b) Grouting operation in number. Each hole grouted complete shall be considered as one operation

c) Cost of cement

12.13.3 Grouting Materials

12.13.3.1 Cement

(i) Measurement for payment for cement used for grouting will be of the quantity, by weight, of cement approved for the different grout mixes specified.

(ii) Payment will be made at the Unit Rate per MT entered in the Bill of Quantities, which shall include the entire cost of provision, delivery, transportation, storage and complying with all requirements specified.

12.13.3.2 Sand, Bentonite

(i) Measurement for payment for sand and bentonite respectively will be of the weight of materials with an average natural water content, obtained from the mixing plant records or by other means approved by the Engineer.

(ii) Payment will be made at the appropriate Unit Rate per MT entered in the Bill of Quantities for respective material.

12.13.3.3 Admixtures and Chemicals

(i) Measurement for payment for admixtures and chemicals will be of the weight of materials obtained from the mixing plant records or by other means approved by the Engineer.

(ii) Payment will be made at the Unit Rate per kg entered in the Bill of Quantities for admixtures, which shall include the entire cost of supply, handling, storage and dispersing.

12.13.3.4 Embedded pipes and Fittings for Grouting

(i) Measurement for payment will be made for the standard mild steel pipes and fittings in rock and concrete.

(ii) Measurement for payment for embedded steel pipes and fittings left permanently in place will be of the weight, regardless of pipe diameter. Payment will only be made for pipes which are installed as ordered or approved by the Engineer or when shown on the drawings. Payment will be made at the Unit Rate per kg entered in the Bill of Quantities, which shall include the entire cost of supply, installation, and protection against blockage of pipes and fittings.

12.13.4 Exclusions

All costs for grouting of the rock bolts, grouted anchor bars, post tensioned rock anchors are excluded from this chapter and will be measured and paid for in accordance with the provision of the chapter-Rockbolts and Wiremesh.

12.13.5 No Measurement for payment or payment shall be made for the following:

(a) Preparation of trial mixes.

(b) Grouting materials used in contact grouting in the crown of the tunnel, shaft and cavern, either concrete or steel lined.

(c) Grouting materials used in mixture which has been prepared more than one hour prior to injecting or which have been lost due to improper handling or rejected due to improper mixing.

(d) Supply and injection of water.

(e) Plugging and caulking leaks during grouting.

(f) Protection of drainage system, if any, during grouting.

(g) Communication facilities required during grouting.

(h) Closure of the holes as specified and clean-up.

(i) Preparation and submission of records and reports on grouting operations.

(j) Drilling and backfilling of such holes which have to be abandoned due to improper drilling by the contractor.

(k) Recleaning or redrilling of holes which are not protected by the contractor before grouting.

(l) Repair of concrete damaged during grouting.

(m) Furnishing of wooden core boxes.

CHAPTER – 13

CEMENT CONCRETE

INDEX

13.1 Scope of Work

(i) The specifications described here-in-under cover all labour, materials, equipment and services related to the concrete work to be carried out by the contractor under this contract.

(ii) The concrete work shall be performed to the dimensions as shown on the drawings or as otherwise directed by the Engineer.

(iii) The contractor shall cooperate with all other contractors and organizations related to the construction of permanent works where the material or equipment is to be fixed to, or embedded in the concrete structures.

(iv) The specifications for shotcrete and SFRS are covered separately in chapter -Shotcrete and are therefore excluded from this chapter.

(v) The approval given by the Engineer to the contractor's plants and equipment or their operation or of any construction methods shall not relieve the contractor of his full responsibility for the proper and safe execution of concrete work or any obligations under this contract.

13.2 Submittals

(i) Submittals listed herein are related to the items which require the consent of the Engineer and are to be made by the contractor before the appropriate work may proceed.

(ii) Within 30 days from the date of issue of the Letter of acceptance, but before procuring or mobilizing to site, the equipment, contractor shall submit to the Engineer, updated and detailed plans and descriptions, consistent with those submitted with his bid and any subsequent amendments and additions agreed to by the Engineer and the contractor of the following:

(a) Aggregate Processing Plants

Description, flow diagrams and drawings in sufficient details to indicate layout, type and capacity of crushing, screening, washing, conveying and other aggregate processing and handling equipment.

(b) Batching and Mixing Plants

Description, flow diagrams and drawing of the plants, and details of the equipments, the contractor intends to use to determine and control the amount of each separate concrete ingredient and mixing thereof into uniform mixture.

(c) Concrete Cooling Plant

Details of refrigeration and ice plants and methods which the contractor proposes to use to comply with concrete temperature requirements

(d) Transport and placing of Concrete

Full details of the equipment and methods for transporting the concrete from the concrete plant to the final point of placing, including numbers, type and capacity of transport vehicles, concrete pumps, and details of standby plants to be installed.

(e) Mode and methodology of concrete curing.

(f) Sampling and Testing of Materials:

List and details of equipment for sampling and testing, detailed program for quality control of concrete work, and qualification and experience of the proposed personnel.

(g) Heating Facilities

Details of methods and equipments which the contractor proposes to use for cold weather concreting to comply with concrete temperature requirements and protection from damage by freezing.

(iii) At least 60 days in advance of any concrete work being carried out on the site, the contractor shall submit to the Engineer, following information:

(a) Details of any admixture and pozzolana which the contractor proposes to use, name of manufactures thereof, and information about the chemical names of the principal ingredients and the likely effect of under or over dosage. Should the contractor intend to use an accelerator in any concrete work for his own convenience; he shall give full details of the type, dosage and influence on construction.

(b) Details of the material for formwork and surface finishes, treatment of construction joints, and construction techniques which the contractor proposes to use in order to achieve the required concrete surfaces and allowable tolerances.

(c) System, methods and equipment for pre stressing steel and grouting of cables in pre stressed concrete elements.

(iv) At least 30 days prior to procuring or despatch to the site of the following items, the contractor shall submit to the Engineer, the following:

(a) Details covering the properties and performance, including the certified copies of reports of all tests made by the manufacturers of waterstops, expansion joint fillers, and joints sealing compounds alongwith samples of the products.

(b) Details of curing compounds.

(c) Details of epoxy mortar for concrete repair.

(d) Details of the cooling system for post cooling of mass concrete.

(v) The location of construction joints proposed by the contractor which differ from those on the drawings, including formwork and reinforcement details, shall be submitted to the Engineer at least 30 days prior to the commencement of work on that particular structure.

(vi) Contractor shall provide the Engineer with a weekly placing schedule giving the detailed location of the pours, the approximate extent of pours, and the date on which the concrete will be placed. This weekly programme of concrete placement shall be submitted to the Engineer for his acceptance at least 2 days prior to the commencement of the week.

(vii) Before commencement of the concrete placement the contractor shall prepare a checklist regarding all preparations for the specified work such as rock surfaces and foundations, cleaning, formwork, reinforcement, embedding, and submit this list to the Engineer, who after his satisfaction about the work preparations will permit the contractor in writing to commence concrete placement.

(viii) The contractor shall keep and make available to the Engineer records of the date, amount, and storage location of each delivery of cement and of the part of the Works in which it was used and shall provide facilities for checking the stock of cement.

(ix) During the performance of the concrete work, the contractor shall keep a diary where he shall record the construction procedures related to concreting. This diary shall be made available to the Engineer upon request. The records shall contain at least the following:

(a) Commencement and termination of concreting of various parts of the structures.

(b) Quantities and quality of aggregates and cement provided and the storage from which they were drawn.

(c) Temperature of air, water, cement, aggregates and concrete.

(d) Meteorological conditions and humidity of air.

(e) Personnel employed during various stages of the concreting operation and name of the responsible inspector or foreman.

(f) Equipment used.

(g) Directives received from the Engineer.

(h) Any special material or procedures employed.

(x) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

13.3 Standards

(i) The concrete materials , production, methods, testing and admixtures shall conform to the following latest Indian Standards or, where not covered by these standards, to the equivalent International standards:

IS:456	Plain and Reinforced concrete-Code of Practice
IS:5878 (Part-V)	Code of practice for construction of tunnels conveying Water Concrete lining

IS:516	Method for Test for strength of concrete.
IS:1199	Method of sampling and analysis of concrete
IS:457	Code of practice for general construction of Plain and Reinforced concrete for dams and other massive structures.
IS:1489	Specification for Portland Pozzolana Cement
IS:9103	Concrete admixtures-Specification
IS:7861(Part–I)	Code of practice for extreme weather concreting Recommended practice for hot weather concreting
IS:7861(Part-II)	Code of practice for extreme weather concreting Recommended practice for cold weather concreting
IS:2505-1980	Concrete vibrators-Immersion type-General requirements.
IS:10262	Recommended guidelines for concrete mix design.
IS:8112	Specifications for 43 grade Ordinary Portland cement
IS:383	Specifications for Coarse and fine aggregates from natural sources for concrete.
IS:11105	Code of practice for Design & Construction of Tunnel Plugs
IS:3025 (Part 1 to Part 56)	Methods of Sampling and Test (Physical and Chemical) for Water Used in Industry
IS:5816	Splitting Tensile Strength of Concrete-Method of Test
IS:11155	Construction of spillways and similar overflow structures - Code of practice
IS:12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams
IS:2386 (Part 1 to Part 8)	Methods of Test for Aggregates for Concrete
IS:4031 (Part 1 to Part 15)	Methods of physical test for hydraulic cement
IS:4032	Method of chemical analysis of hydraulic cement
IS:1199	Methods of sampling and analysis of concrete

(ii) In cases of conflict between the above Standards and the specifications given herein, the specifications shall take precedence.

13.4 Quality Control and Testing

13.4.1 General

(i) The contractor shall be completely responsible for performing detailed quality control program during the execution of the work. This quality assurance program shall be subject to inspection and checking by the Engineer.

(ii) The Contractor shall keep records of tests results which shall be presented to the Engineer upon request.

(iii) Should the contractor wish to reduce his approved testing program he shall notify the Engineer of these changes 2 weeks in advance.

(iv) Aside from contractors testing program the Engineer will make control test to the extent as he deems necessary. The contractor shall give all required assistance in sampling and provide for the proper storage and transport of the specimens to be tested by the Engineer.

(v) The Contractor shall made such arrangements or purchase a new equipment should the test results prove that changes in the aggregates or concrete plant are necessary to obtain required concrete quality.

13.4.2 Site Laboratory

(i) The contractor shall build, equip, and operate the site laboratory in which the tests included in the Quality Control Program will be carried out. In some cases where special tests are required, they will be carried out by the contractor in other specialized laboratories after approval by the Engineer.

(ii) The laboratory shall be equipped with all the necessary equipment to carry out the tests indicated below.

a) Tests on aggregates as per relevant IS codes

-Sieve analysis

-Crushing strength

-Compressive strength

-Specific gravity

-Water absorption

-Flakiness

-Sand equivalent

-Soundness and organic matter

-Los Angeles abrasion

-Cleaniness

-Bulking

-Impact value

-Density

-Alkali Aggregate Reactivity

-Crushing value

b) Tests on cement

- Equivalent alkaline content (IS 4032)

-Specific Blaine surface (IS 4031 (6))

-Standard Mortar Compressive Strength (IS 4031 (6))

-Shrinkage (IS 4031(10))

-Heat of hydration (IS 4031(9))

-Setting time (IS 4031 (5))

-Soundness

-Consistency

-Density

-Expansion

c) Test on fresh concrete

-Consistency through slump test (IS 1199)

-Workability

-Heat of hydrations using thermometers, cells, and recording instruments.

-Entrained Air

-Density

-Workability

-Temprature

d) Test on hardened concrete

-Compressive & Tensile strength on all classes of concrete (IS 516)

-Shrinkage IS 4031 (10)

-Water tightness

e) Tests on Admixture

-Dry material content

-Ash content

-Relative density

-Chloride Ion Content

-pH

(iii) The site laboratory shall be properly air-conditioned and equipped with temperature and relative humidity recording instruments.

13.4.3 Concrete Sampling and Testing

13.4.3.1 Aggregates

(i) Aggregate samples shall be taken from silos at the batching plant or from the conveyor belt.

(ii) The sampling shall be done at the frequency of one every 1,000m^3 of produced concrete (cumulative of all concrete classes) and once a week at minimum

(iii) Tests as per Clause 13.4.2 (ii)a will be carried out.

13.4.3.2 Cement

(i) Quality control of cement shall first take place at the cement factory. This will be exercised by the factory itself under the supervision and the follow-up of the Contractor who shall submit the copies of test results of cement to the Engineer for final approval. The quality control program will be established jointly with the Contractor and shall be submitted for the approval of the Engineer. To ensure that this quality control program is properly conducted, the contractor shall post at the factory one of his officials, when necessary.

(ii) The requirements on the site laboratory are stipulated in the Chapter " Site Installations and Services".

(iii) Once a train has been loaded at the factory and is ready for departure, six samples will be taken in six different cars and mixed in order to prepare one unique sample which will be split into two parts.

-The First part will be analyzed by the cement factory Laboratory,

- The Second part will be dispatched to the site laboratory

iv) Tests as per Clause 13.4.2 (ii)b shall be carried out at both laboratories and compared.

v) Furthermore, each week, a sample of cement shall be taken at the batching plant and tests as per Clause 13.4.2 (ii)b shall be carried out.

13.4.3.3 Admixtures

(i) Admixtures to be used for concrete production shall satisfy details as per Clause 9.5 of Technical Specification and be tested for their suitability with the cement and other materials under actual working conditions. Each shipment of admixtures shall be tested for density and dry extract.

(ii) Tests as per Clause 13.4.2 (ii)e shall be carried out.

(iii) Admixtures older than 12 months after their fabrication shall be tested for deterioration.

(iv) Shipment of which the tested sample do not pass the criteria shall be rejected.

13.4.3.4 Water

A sample of water will be taken from the concrete batch plant every 3 months and submitted to chemical analysis as described in IS 3025.

13.4.3.5 Fresh Concrete

(i) Tests as per Clause 13.4.2 (ii)c will be carried out.

(ii) These tests shall be carried out at the beginning of manufacturing of the concrete for each work or part of the work and for large quantities once every 100m^3.

(iii) All consistency tests shall be determined on that portion of the total sample which passes a 40mm size.

(iv) Air content shall be determined in accordance with established standard

(v) One air tests (0.006 m^3 capacity bowl) is required at the beginning of each shift, whenever a class change occurs, whenever air test results are deviating from specifications and at 500m^3 intervals for each class of concrete in production.

(vi) Routine air tests as noted above will be determined on that portion of the total sample which passes a 40mm sieve size.

13.4.3.6 Hardened Concrete

(i) Set of six samples for compressive strength tests at 7 and 28 days will be taken and tested for each part of the work, being defined as the volume poured in one concerting operation.

(ii) For large concreting operations, this set of sample will be taken every 200m^3

(iii) Compressive strength specimens shall be prepared by the Contractor and shall be performed in accordance with Indian standards and Code of Practice.

(iv) All coarse aggregate larger than one quarter the minimum dimension of the mould will be removed by wet screening. Portions of samples of concrete used for slump, air content, unit weight etc. will not be used to mould specimens for compressive strength testing.

(v) Tests as per Clause 13.4.2 (ii)d shall be carried out.

13.4.3.7 Concrete Plant

Monthly checks, or when requested by the Engineer of the concrete plants weight-batching accuracy, including the accuracy of any admixture dispenser, shall be made by the Contractor in the presence of the Engineer. When checked by standard weights and volumes its accuracy shall be within 0.5% or as specified by the manufacturer.

13.4.4 Analysis of Results

(i) The tests results will include the different components analyses, the values obtained on fresh and hardened concrete and the characteristics of the corresponding batch given by the printer of the batching plant.

(ii) The contractor shall present regularly to the Engineer a synthesis of all the results in the form of tables, charts, statistical analyses (weekly and monthly reports).

13.4.5 ACCEPTANCE CRITERIA

13.4.5.1 Concrete Components

(i) The measured values shall be within the acceptable range as per relevant IS standards

(ii) Any unsuitable material should be eliminated and the concrete manufacturing be suspended until the contractor justifies that the replacing component is acceptable.

13.4.5.2 Fresh Concrete

Any controlled batch which will not satisfy the specified conditions in terms of consistency, air content and temperature will be eliminated and concreting suspended until it is shown that corrections brought to the following batches are satisfactory.

13.4.5.3 Hardened Concrete

(i) The acceptance criteria for hardened concrete shall be as per IS: 456

(ii) If analysis of test cube results indicate poorer concrete in the structure as per the acceptance criteria of IS:456, the Engineer will order the Contractor to provide core tests, Location and number of cores will be decided by the Engineer. The Contractor shall take out the specified sizes of cores from the structure.

(iii) In case of concrete cores fail to meet the specifications and the Engineer is not satisfied with various tests results and quality, he will then instruct the contractor for removal or subsequent suitable strengthening for such works.

(iv) The contractor shall fill the test holes left by the removal of the cores with concrete of the required strengths to the satisfaction of the Engineer.

13.5 Proportioning of Concrete

13.5.1 General

(i) Denomination of concrete classes is based on the nominal cube compressive strength (in Newton per square mm) and maximum aggregate size.

(ii) The cube compressive strength is defined as the strength as measured at 28 days. The strength shall comply with the requirement of IS: 456.

(iii) The following table shows, in general the anticipated classes of concrete required in various sections of work. The specific class of concrete to be used in each area will be shown on the construction drawing or designated by Engineer.

Class of concrete	Max. size of aggregate. (mm)	Nominal cement content (kg/m^3)	Max. slump (mm)	28-day strength (N/mm^2)	Location (Tentative)
M30	10	500	120	30	Selected locations for second stage concrete around Embedded Parts
M30	20	425	120	30	Intake Invert
M25	40	400	120	25	Pond & Intake structure, Lining of Hydraulic Tunnel and shafts, Beams columns slabs, foundations etc.
M20	40	350	120	20	Various unspecified locations
M15	20	275	120	15	RCC Lagging in underground works
M15	40	260	120	15	Various unspecified locations
M10	80	150	50	10	Lean and Plum Concrete
M10	40	220	50	10	Lean and Plum Concrete

(iv) At least 4 months prior to commencement of any concreting of Permanent Works, the Contractor shall start the testing of materials, propose the composition of concrete mixes and prepare trial mix of each of the proposed concrete class. The Contractor shall prepare the trial mixes using the cement

water, aggregates and admixtures intended for the work and which conform to the requirement specified in this Chapter.

(v) Contractor shall determine, in accordance with IS standards and/or ACI Manual of Concrete Practice, the mix proportions for the designated classes of concrete. The contractor shall submit the test reports to the Engineer for approval. This preliminary test program shall include the determination of following parameters.

a) Cement properties,

b) Characteristics of aggregates,

c) Mix water properties,

d) Admixture properties,

e) Proportion of aggregate ranges in the mix,

f) Proportion of uncrushed to crushed aggregates,

g) Cement content,

h) Water-cement ratio (W/C),

i) Workability of concrete mixes,

j) Compressive and tensile strength,

k) Entrained air

l) Density,

m) Water-tightness.

(vi) These test shall be carried out until the concrete mixes show appropriate strength, workability, density, and water-tightness without the use of excessive cement and water. The actual cement content in the mix design shall be optimized and justified by using cement of approved manufacturers during trial mix design.

(vii) To carry out these preconstruction tests full scale machine-mixed test batches shall be made and test samples taken there from. Tests shall be made in ample time so that complete and acceptable results are available before concreting of structure.

(viii) Test samples shall be made in accordance with IS: 1199 and tested in accordance with IS: 516. The test results shall be analysed in accordance with IS: 456.

(ix) The mixes for different classes of concrete shall be approved by the Engineer.

(x) During the progress of the work, the mixes may be changed whenever, in the opinion of the Engineer. such change is necessary or desirable to secure the required strength, workability. water-tightness, density, economy, or to limit shrinkage. The Contractor shall not change the approved mix proportions without the written permission of the Engineer.

(xi) Water to be added to the mix shall be adjusted to compensate for any variation in the free moisture content of the aggregate as they enter the batch plant. Water beyond the specified water-cement ratio shall not be added without the written permission of the Engineer.

13.5.2 High Performance Concrete

(i) High performance concrete shall be obtained by adding silica fume in the concrete and with the use of superplasticizer. Following are the design requirements:

Characteristic 28 days compressive strength	60 Mpa & 70 Mpa
Maximum aggregate size	20mm
Design slump	120mm
Maximum water (cement+ silica fume) ratio	0.32

To achieve the above requirement, tentative mix design may consist of the following

Cement	450 Kg
Silica fume	35kg
Superplasticizer	As Required

(ii) Actual mix proportion to be used will be determined by trial mix design.

Test samples shall be made in accordance with IS: 1199 tested as per IS 516 and analyzed as per IS: 456. Source of aggregate for high performance concrete shall meet the requirement of wearing surface and shall be as identified by Engineer.

(iii) Silica fume shall comply with ASTM C 1240-03a. It shall meet the following requirements.

Chemical Requirements

(a)	Sio_2 min. %	85
(b)	Moisture Content %	3
(c)	Loss on ignition%	6

Physical Requirement

Percent retained on 45um (no. 325), %	10
Max. variation from average, percentage points	5
Accelerated pozzolanic strength activity index with portland cement at 7 days,	10
min. percent of control	5

Specific surface, min. m^2/g	15

The contractor shall present the results of quality control tests carried on a representative sample by the supplier. Once approved, the silica fume shall only be supplied from the same production plant. Deliveries shall be in impervious sacks weighing about 40 kg and shall be accompanied by manufacturers quality assurance certificates.

13.6 Handling of Aggregates

(i) The coarse aggregates shall be stacked in three stock piles, designated 80mm to 40mm, 40mm to 20mm and 20mm to 4.75mm nominal size aggregates. A separate stock pile shall however, be made for 150mm nominal size aggregate.

(ii) If tests indicate that separation of the 10mm and lower sizes is required, a separate pile shall be made for this aggregate.

(iii) The fine aggregate, having the required grading shall ordinarily be stacked in two piles, one of which washed and drained and other freshly washed, to minimize the variation in the moisture content.

(iv) Where crushed fine aggregate replaces a part natural fine aggregate, the two shall be stacked as independent stockpiles

(v) It may be necessary to have two or three pile by sizes, in case of natural fine aggregate to get required grading.

13.7 Batching and Mixing

13.7.1 General

(i) The contractor shall provide, operate and maintain at the site automatic batching equipment to determine and control the amount of each individual material entering the concrete. Batching equipment shall be designed for such capacities which will permit performance of the concrete work in accordance with Contractual Construction Program.

(ii) Water, cement, admixtures, fine aggregate and coarse aggregate shall be measured separately and not cumulatively. The accuracy of the measuring devices shall be maintained so that the indicated measure does not vary by more than 1 percent from true measure throughout their range of use. The devices shall be capable of being operated to control the delivery of materials so that the combined inaccuracies in feeding and measuring do not exceed the following limits

Material	Percent (by weight)
Cement	1
Water	1
Aggregates	3

Admixtures	1

13.7.2 Batching Equipment

(i) At the batching plant, standard certified test weight shall be provided and such other auxiliary equipment as may be necessary to check the operating performance of each scale or other measuring device. When required by the Engineer, operator shall make these tests in his presence. Unless otherwise required by the Engineer, check test of equipment used for measuring water, cement aggregates and admixtures shall be made at least every week. After completion of each check test, operator shall report the results to the Engineer and make such adjustment, repairs or replacement as the Engineer deems necessary to secure satisfactory performance before further use of the measuring devices.

(ii) The batching equipment shall be capable of handling a minimum of three different sets of mix proportions concurrently, without having to reset scales manually, and recording the number of batches of each mix separately.

(iii) Each measuring unit shall include a visible springless dial (metric) which will register the scale load at any stage of the measuring operation or shall include an over-and- under indicator which will show the scale in balance at no load when loaded to the beam setting. The masses of the components of each batch shall be automatically recorded and the records submitted to the Engineer at daily intervals.

(iv) Each measuring indicator and volume measuring device shall be in full view of the operator, and the measuring equipment shall be arranged so that the operator may conveniently observe the operation of the bin gates, the materials discharging into the mixer and the concrete during mixing and discharging. The batch panel shall be equipped with chatter controls to control the dribble for each material batched and a volume selector capable of settings from $1m^3$ up to the mixer capacity in increments of $1m^3$.

(v) The batching equipment shall be so constructed and arranged that the sequence and timing of the batcher discharge gates can be controlled to produce an intermixing of the aggregate, water and cementing materials, as the materials pass through the charging hopper into the mixer. The batching controls shall be so interlocked that a new batching cycle cannot be started until all the weighing hoppers are completely empty.

(vi) The operating mechanism in the water measuring device shall be such that no leakage will occur when the valves are closed and the discharge valve cannot be opened until the filling valve is closed.

(vii) The device for adding admixtures shall be interlocked with the batching and discharging operation of the water so that the batching and discharging of the admixtures will be automatic. The device shall be capable of permitting the quantity of admixture being batched to be adjusted should this prove necessary and shall be equipped with a suitable warning device to indicate when the level in the reservoir tank is low.

(viii) A calibrated container shall be incorporated in each admixture holding system such that normally the admixture will bypass the container during batching. However, at anytime it will be possible to direct the batched material into the container to check the accuracy of measurement.

(ix) The batching equipment shall include an accurate recorder for providing a continuous visible record of the measurement of each separate material, including all added water and admixture.

(x) The measuring and recording equipment shall be supported on foundations independent of those for the mixing plant to prevent them from being affected by vibration.

(xi) Effective communication system including telephone shall be provided between the concrete plant and the point of placement at all times, and such facilities shall also be available at either location for use by the Engineer as required.

(xii) Volume batching will not be permitted.

(xiii) In case of use of fully automated batching plant, all the recording and indicating system intentioned above shall be available and on-line control of all components of the batching plant shall be provided.

13.7.3 Mixing

(i) Concrete shall be mixed in a power-driven stationary batch mixers of approved type and size. They shall be kept clean and in proper working order. The mixing blades in the drum shall be replaced when worn by 10% of their design dimensions.

(ii) Movable truck mixers shall not be permitted for mixing concrete mixes.

(iii) The batching plant shall be provided with a bypass such that the mix materials can be discharged directly into a transit mixer drum. This bypass is to be used only in emergency and with permission of the Engineer.

(iv) The mixing equipment shall be capable of combining the aggregate, cementing materials, water and other ingredients, within the time hereinafter specified into a thoroughly mixed and uniform mass, and of discharging the mixture without segregation.

(v) The mixers shall be so charged that some water will enter in advance of cement and aggregate and all materials shall continue to flow in as rapidly as possible. The construction of the mixers should prevent loss of materials during charging.

(vi) The mixers shall not be charged beyond their rated capacities and the entire contents of the mixer shall be discharged before recharging

(vii) Unless otherwise authorized by the Engineer for mixers of 1m^3capacity or less, the mixing of each batch shall continue for not less than 1.5 minutes as

specified in IS 456 (but not more than 5 minutes when mixing air-entrained concrete) after all materials, except the full amount of water, are in the mixer. For mixers of larger capacity, the minimum mixing time will be increased by 15seconds for each additional 0.5m^3

(viii) The mixing time shall be increased when, in the opinion of the Engineer, the charging and mixing operations fail to result in the required uniformity of composition and consistency within the batch and from batch to batch.

(ix) Mixers shall be rotated at the rate recommended by the manufacturer of the mixers.

(x) The arrangement for controlling, measuring and mixing operations shall be such that the operator may observe the concrete discharging from the mixer.

(xi) Each mixer shall be equipped with a mechanically or electrically operated timing and signaling device for indicating and assuring the completion of the required mixing period and for counting the batches.

(xii) Should a mixer at any time prove unsatisfactory, it shall be replaced or its use discontinued until it is made satisfactory.

(xiii) Each mixer shall be cleaned after each period of continuous operation and shall be maintained in such a condition that the mixing action will not be impaired.

(xiv) Where the distance between the batching plant and a concrete pour is such that it would in the opinion of the Engineer cause deterioration of mixed concrete in transit, dry batching may be permitted using transit mix trucks in accordance with IS :457. Water shall be added not later than 30 minutes after batching.

(xv) On no account shall any addition be made to any component of a concrete batched once that batch has been mixed and discharged from the mixer, whether for the purpose of retempering or for any other reason.

(xvi) Batching and mixing of concrete shall not commence unless due notice, at least 24 hours in advance, has been given to the Engineer and written approval has been obtained for the placing arrangements, and for the preparation and accuracy of the part of the Works in which concrete is to be placed.

13.8 Hot and Cold Weather Concreting

13.8.1 Temperature of Concrete

(i) The maximum permitted temperature rise in concrete and temperature distribution after placement will be determine by the Engineer based on the laboratory test performed prior to the start of concrete work using the actual cement, concrete mix proportions, and diffusibility for the concrete under consideration, or by actual field monitoring .

(ii) As a general rule ,the maximum temperature developed after placement should not be higher than 55-60º C, and the temperature difference within the pour or lining should not exceed 20ºC. For linings of pressure tunnels and shafts this values shall be limited to 50ºC for maximum heat of hydration, and 10ºC maximum temperature gradient in any section of the lining.

(iii) The temperature of concrete when being placed in hot weather shall be as follows, unless otherwise permitted by the Engineer.

a) Mass Concrete (max aggregate size 40mm) in concrete plugs in diversion tunnel and tunnel adits not more than 13ºC.

b) Structural, tunnel lining, and dam facing concrete, not more than 20 ºC.

c) All other concrete, not more than 30 ºC.

(iv) The contractor shall supply and install thermocouples in the fresh concrete in the headrace tunnel, and desilting basins, and perform temperature measurement.

(v) The temperature of concrete when being placed in cold, weather shall be as follows:

a) Mass concrete, not less than 7 ºC.

b) Structural concrete, not less than 10 ºC.

c) Structures thinner than 300mm, not less than 13 ºC.

(vi) Cold weather conditions will be considered to be in effect when the mean daily temperature drops below 5ºC for more than 3 successive days.

(vii) When temperatures above10 ºC. occur during more than, half of any 24-hour period, the concrete should no longer be regarded as “Winter Concrete” and normal concreting practice should apply.

13.8.2 Hot Weather Precautions

(i) The contractor shall furnish, install, operate and maintain, equipment and make the necessary provisions in order to maintain the temperature of concrete, when being placed below the maximum temperatures specified above.

(ii) Following means shall be employed to attain the specified concrete temperatures.

a) Pre-cooling of coarse aggregate by sprinkling, immersion in cold water or with cold air blast.

b) Refrigerating the mixing water or adding the chip or flake ice as a portion of the mixing water

c) Insulating the water tanks and water supply lines, cement silos, mix drums, exposed pipelines for pumped concrete and sheltering the aggregates.

d) Mixing and placing the concrete at night.

e) Using cement having low heat of hydration.

f) Post cooling arrangement

(iii) Ice, when used for mixing water, shall be completely melted before mixing is completed.

(iv) The temperature of concrete at the mixing plant shall be 2ºC lower than the placing temperature specified above.

(v) The contractor concreting operations shall be in accordance with the recommendations contained in IS: 7861(Part I).

(vi) The use of liquid nitrogen in lieu of ice may be permitted by Engineer after review of proposed details for its use submitted by the Contractor.

13.8.3 Cold Water Precautions

(i) The contractor shall furnish, install, operate, and maintain equipment and make the necessary provisions in order to maintain the temperature of concrete, when being placed, above the minimum temperatures specified.

(ii) Following means shall be employed to attain the specified concrete temperatures.

a) Mixing water shall be heated under such a control and in sufficient quantity as to avoid appreciable fluctuation in temperature from batch to batch.

b) Insulating the water tanks and water supply lines, cement silos, mix drums, expose pipelines for pumped concrete and sheltering the aggregates.

c) Mixing and placing the concrete during day.

d) Using calcium chloride in concrete, about one percent by weight of cement. Calcium chloride shall, however, not be used in concrete which shall be subjected to sulphate attack or where galvanized metal parts are embedded.

(iii) The contractor's concreting operations shall be in accordance with the recommendations contained in IS 7861(Part II)

13.9 Conveying

(i) Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods which shall prevent segregation and / or loss of ingredients. In case such separation occurs, concrete shall be remixed before being laid in place, and accordingly, the distance between the mixer and the place of concreting as also the mode of transport of concrete shall be chosen by the contractor which shall always be subject to modifications, if so desired by the Engineer at no cost to Employer.

(ii) Concrete shall be deposited in the final position as early as practicable but always within a period of 60 minutes after mixing. This limit may be modified by the Engineer to suit working or weather conditions.

(iii) Plant, such as buckets, cars, conveyors, and pumping equipment, which may be used for conveying concrete shall be of such size, design and condition as to ensure an even and adequate supply of concrete at the placement area.

(iv) Particular attention shall be paid to prevent segregation at the ends of chutes, at hopper gates and at all other points of discharge.

(v) Methods of conveying concrete of any part of the structure wherein the concrete is loaded into chutes, belt conveyor or other similar equipment and carried in a thin continuously exposed flow to the forms shall not be permitted except for very limited or isolated sections of the work, and only when approved in writing by the Engineer.

(vi) Where chutes are used, they shall be so constructed and arranged as to permit continuous flow of the concrete without separation of the ingredients. Chutes shall not have a slope steeper than 1 V: 2 H.

(vii) There shall be no vertical drop greater than 1.5m except where equipment satisfactory to the Engineer is used to confine and control the falling concrete.

(viii) Concrete may be dropped through flexible elephant-trunk chutes, provided some method is used at the lower end to retard the speed of the falling concrete and prevent it from segregating.

(ix) Buckets for transporting concrete shall be manufactured as low-slump concrete buckets.

(x) The conveying plant shall be kept free from hardened concrete and foreign materials and shall be cleaned at frequent intervals.

(xi) During hot or cold weather, concrete shall be transported in deep containers as such containers, on account of their lower ratio of areas to mass, reduce the rate of loss of water by evaporation during hot weather and loss of heat in cold weather.

(xii) All conveying plant shall be supported independently of the forms, except as specifically permitted by the Engineer.

(xiii) Capacity of conveying plants shall be such that required progress on different itmes of work is achieved and maintained.

13.10 Placing of Concrete

13.10.1 General

(i) No mortar or concrete shall be placed except in the presence of the Engineer.

(ii) The contractor shall provide Engineer with a weekly placing schedule giving the detailed location of the pours, the approximate extent of pours and the date on which the concrete shall be placed.

(iii) Concrete shall be placed only in locations where authorized and no concrete or mortar shall be placed until form work, installation of reinforcing steel, steel ribs, piping and other embedded parts, preparation of surface and necessary clean up have been done and checked and certified by the Engineer as being in conformity with specifications and drawings.

(iv) Concrete placed without prior knowledge and approval of the Engineer may be required to be removed and replaced.

(v) Earth foundation on which concrete is to be laid shall be firm drained soil, free from any soft mud or other objectionable material.

(vi) Whenever concrete is to be placed on earth, a layer of lean concrete shall first be placed before placing concrete of the specified grade. The thickness of such layer of lean concrete shall be as shown on the drawings or as directed by the Engineer.

(vii) No concrete shall be placed in running water. Water shall, generally, not be allowed to flow over freshly poured concrete until final set has been achieved.

(viii) Immediately, before placing concrete, all such surfaces upon which concrete is to be placed shall be thoroughly cleaned by the use of high velocity air and water jets or sand blasting, steel brooms, picks or other effective means, satisfactory to the Engineer.

(ix) All pools of water from the surface on which concrete is to be placed shall be cleaned to ensure proper bonding of fresh concrete with the rock surface. The method of disposal of water in working sites shall be subject to the approval of the Engineer.

(x) Sufficient mixing and placing capacity shall be provided so that the work may be kept alive and free from cold joints. Formed concrete shall be placed in horizontal layers, avoiding inclined layers and constructions joints.

(xi) To get a monolithic placement, it is important that each layer be shallow enough so that the previous layer is still soft and the two layers are vibrated together.

(xii) Concrete shall not be allowed or caused to flow horizontally or on slopes in the forms.

(xiii) Concrete placing on slope shall begin at the lower end of the slope and progress upward, thereby increasing compaction of concrete.

(xiv) In pneumatic placement of concrete, usual high velocity discharge shall be reduced to a point where no separation and scattering of the concrete occurs.

(xv) In order to reduce bleeding, slump shall not be more than necessary to achieve proper placement and consolidation.

(xvi) All care shall be taken to avoid separation of coarse aggregate from the concrete. Obvious groups and clusters of separated coarse aggregates shall not be permitted. They shall be removed before the concrete is placed over them, otherwise they may cause serious imperfections in the finished work. Hence particular attention shall be paid to the tendency for objectionable separation to occur at the points of discharge so that uniformity and homogeneity of concrete in placement and good workmanship is assured.

(xvii) The concrete shall drop vertically into the centre of whatever container receives it. To protect the rods, spacers, and embedded features from damage and to prevent displacement of reinforcement, concrete falling in forms shall be confined in a suitable drop chute.

(xviii) The contractor shall take the following precautionary measures while concreting the reaches of the tunnel having high temperature and hot humid conditions to over come the problems of placement of concrete and its curing:

a) Producing adequately cooled concrete to ensure proper placement temperature taking in to account the addition of heat during travel time through hot zone.

b) Restoring to short mixing time.

c) Use admixtures like water-reducer/retarders, which retard the rate of hydration & the setting time under high temperature conditions.

d) Take care in placement and curing of concrete.

13.10.2 Preparation for Placing of Concrete

(i) All surfaces on which or against which concrete is to be placed, including surfaces of construction joints between successive concrete placement, reinforcing steel and embedded parts, shall be thoroughly cleaned of dirt, mud, debris, grease, oil dried mortar or grout, laitance, loose particles or other deleterious matter.

(ii) Surface seepage and other water shall be so controlled, to the satisfaction of the Engineer, that at no time during the placement or hardening of the concrete will it wash, mix with, or seep into the concrete.

13.10.3 Concrete Placement

(i) The method and equipment used for placing concrete shall be such as shall permit the delivery of concrete of the required consistency into the work without objectionable delay, segregation, porosity or loss of workability.

(ii) All surfaces of forms and metal work including reinforcement bars that have become encrusted with dried mortar or grout from concrete previously placed, shall be cleaned of all such matter or grout before the surrounding or adjacent concrete is placed.

(iii) Concrete shall be placed in lifts as shown on the drawings or as directed by the Engineer.

(iv) In reinforced concrete work, which has congested parts, care shall be taken to see that all the bars are properly embedded and that no voids are left. On flat, horizontal surfaces, where the congestion of steel near the forms makes placing difficult, a mortar of the same cement sand ratio as is used in the concrete shall be first deposited to cover the forms.

(v) After the surfaces have been prepared, all approximately horizontal surfaces or rock and construction joints shall be coated with cement slurry of water cement ratio approximately of 0.60 by weight or as directed by the Engineer. It shall then be covered with layers of mortar approximately 50 mm to 75 mm thick for rock surface and approximately 15mm thick for construction joints. The mortar shall have the same proportion as that of concrete mix unless otherwise prescribed by the Engineer. The consistency shall be suitable for placing and working in the manner here-in-after specified. The mortar shall be spread uniformly and thoroughly with stiff brooms into all irregularities of the surfaces. Concrete shall then be immediately laid upon the fresh mortar.

(vi) No concrete shall be placed in running water or during rain, high winds, dust storms, excessive heat or cold and similar conditions without prior approval of the Engineer.

(vii) In all cases, concrete shall be deposited as nearly as practicable directly in its final position and shall not be caused to flow by vibrators or otherwise in a manner which shall permit or cause segregation.

(viii) The maximum time interval between placing successive layers within a lift shall not exceed 30 minutes. However, depending upon job requirements and climatic conditions, the Engineer can allow to increase this time interval using appropriate methods of vibration / agitation.

(ix) Concrete shall not be piled up in the forms in a manner that causes movement of the unconsolidated concrete, or permits mortar to escape from the coarse aggregate.

13.10.4 Rate of Placing of Concrete

(i) Concreting shall be done as a continuous operation until the structure or section is completed or until a satisfactory construction joint can be made. The contractor shall make all arrangements necessary to maintain continuity of concrete placing in any particular pour during meal periods, shift changes, or any other such interruptions.

(ii) Concrete shall not be placed faster than the placing crew can compact it properly.

(iii) In placing thin members and columns, precaution shall be taken against too rapid placement which may result in movement or failure of the form due to excessive lateral pressure. An interval of at least 24 hours, unless otherwise approved or directed by the Engineer, shall elapse between the completion

of columns and walls and the placing of slabs, beams or girders supported by them.

(iv) The rate of placing shall be such as to have no objectionable effect on placement of concrete, particularly near the forms and in and around embedded equipment where the rate shall not exceed the limit placed by the Engineer.

13.10.5 Consolidation of Concrete

(i) Consolidation of newly placed concrete shall ordinarily be done with internal vibrators of approved design. The equipment for vibration shall have adequate power and shall be of high frequency, rugged and reliable.

(ii) Operators of vibrators shall be experienced, competent in handling these devices.

(iii) Ample stand-by-units and parts as well as systematic servicing shall be provided.

(iv) Vibrators shall not be used to cause concrete to move more than a short distance laterally; otherwise fine wet material may run ahead and separate from the coarse aggregate.

(v) Revibration shall be resorted to only after specific instructions are given by the Engineer.

(vi) Where vibration is used to full advantage for consolidation of newly placed concrete, no supplementary rodding or other working of the concrete is necessary.

(vii) Concrete shall be compacted and worked into all corners and angles of forms, obstructions, blockouts, locations with congested reinforcement and around embedded items. Special care shall be taken to attend to these places with ample, properly applied additional vibration or rodding as the case may be, without permitting the concrete materials to segregate.

(viii) Internal vibrators of approved weight and frequency 7000 to 9000 r.p.m to secure maximum consolidation shall be used.

(ix) External i.e., form vibrators of an approved type shall be used only in inaccessible locations and where it is impracticable to use immersion type vibrators after their use has been specifically authorized by the Engineer. The form vibrators shall be designed to received vibrations without losing shape and causing leakage of mortar.

(x) The immersion type mechanical vibrators, complying with IS:2505 (Latest revision) electric, air driven or diesel, shall generally be inserted vertically and the vibrating head shall be allowed to penetrate under the action of its own weight. In very shallow concrete, some consolidation can be obtained by using vibrators in horizontal position.

(xi) Internal vibrators, when used, shall be inserted at regular intervals and vibration, with the vibrator fully into the layer being compacted, shall be continued till acceptable degree of compaction has been achieved taking care to avoid excessive vibration which may result in the top containing excessive paste and laitance.

(xii) The entire depth of new layer of concrete shall be vibrated and ordinarily the vibrators should penetrate the layer below (which has not yet become rigid) for several millimetres to ensure thorough bond between the layers.

(xiii) Under ordinary job conditions, there is little likelihood of damage from direct revibration of lower layer or by vibration transmitted by embedded steel provided the disturbed concrete still is or again becomes plastic. Vibrators shall not however, be inserted into lower courses that have commenced final set nor shall they be directly applied to or allowed to disturb reinforcement extending into hardened or partially hardened concrete.

(xiv) Systematic spacing of points of vibrators shall be established to ensure that no portions of the concrete are missed. It shall be ensured that zones of influence overlap and the concrete is properly consolidated.

(xv) In compacting the surface of a concrete lift, the coarser particles of the aggregate in the surface shall be embedded while the concrete is being vibrated, but the surface left with the desired degree of roughness.

(xvi) Disturbance of the surface concrete at construction joints during early stage of hardening shall be avoided. Necessary traffic on new concrete shall be on timber walkways constructed so as not to cause injury to the concrete.

(xvii) When smooth surfaces are required, for all surfaces which shall be permanently exposed to the weather and for all surfaces next to embedded metal work around which it is desired to prevent leakage, the adjacent concrete shall be properly vibrated, spaded or tamped.

(xviii) To ensure even and dense surfaces which are free from aggregate pockets, honey combing or air holes, it may be necessary to supplement internal vibration with hand spading or tamping all along the boundaries of the concrete and around embedded parts, while the concrete is plastic under vibrating action.

13.11 Concreting in Underground and Open Works

13.11.1 Tunnel Concrete Lining

(i) Concrete to be used for the tunnel concrete lining shall be of the grade as specified on the drawings or as directed by the Engineer.

(ii) The contractor's proposed method of concrete placement is subject to the approval of the Engineer.

(iii) Contractor shall propose a sequence of tunnel lining, which is to be approved by the Engineer.

(iv) The tunnel lining shall either be poured in sections or by continuous pouring. If the contractor wishes to use the later method, then he shall first satisfy the Engineer that the concrete production, transport and placing equipment to be used has sufficient capacity to produce and handle the quantity of concrete necessary for continuous pouring of the lining sections. In addition, the contractor shall submit details of the steps to be taken in the event of an interruption in the concrete supply.

(v) The steel reinforcement required in the concrete lining, based on the result of the rock mechanics tests performed in the excavated tunnel, shall be as shown on the drawings,

(vi) Openings for communication with the drainage trench (where executed) shall be left in the concrete lining to serve as cleaning and control pits at intervals not exceeding 100m, or where directed by the Engineer. After fill grouting of the entire system of temporary invert drains, these openings shall be filled with concrete of specified grade containing a nonshrink agent.

13.11.2 Concrete Plug in Adit/Diversion tunnel

(i) When no longer required for access purposes, the adits/ Diversion tunnel shall be plugged with the concrete of the grade as specified on the drawings or as directed by the Engineer.

(ii) The concrete in adit/ Diversion tunnel plugs shall be placed in two stages comprising initial lining and final mass concrete respectively, as indicated in the drawings

(iii) The final concreting of the plug shall be done in multi-lifts but in no case the lift height be exceeded by 1.5 m to control the temperature rise. Each lift shall preferably be cast in one go in the entire length of plug without any construction joint. The concrete placed in one lift of the plug shall be allowed to cool and shrink before concreting of the next lift. The lift height and time interval between successive lifts shall be regulated with the approval of Engineer.

(iv) Special care shall be taken to ensure that there is a proper and effective bond between two lifts. The surface of old concrete shall be thoroughly cleaned and prepared as per the provisions of Para 13.12. Green cutting or sand blasting shall be resorted to for preparation of surface to expose the coarse aggregate.

(v) The placement temperature of plug concrete shall preferably be maintained at about 13° C. Alternatively, if this limit is exceeded, the contractor shall supply and install a cooling system to limit the temperature rise in the plug concrete. The system shall consist of steel pipes installed on top of each lift of the plug concrete and shall incorporate a temperature measuring system to monitor temperature within the concrete mass. Cooling shall start when concrete placing begins and continue until the concrete has cooled to the temperature of the surrounding rock. The difference of temperature between surface of concrete and hot core of concrete element should not exceed 20° C.

(vi) Once cooling of the concrete plug is no longer required, contact grouting between plug and the surrounding rock or tunnel lining, grouting of construction joints and grouting of the air vents and drainage pipes installed shall be carried out in accordance with the requirements of chapter “Drilling and Grouting”. Grout shall be forced through previously installed longitudinal feeder pipes along the adit axis, with radial riser pipes extended into the surrounding rock or tunnel lining.

(vii) Special care shall be taken by the contractor for thorough grouting at rock/concrete and concrete / concrete interfaces. To meet this requirement, a system of grout pipes and outlets and vent pipes shall be installed to grout the gap between the first and the second stage concrete.

(viii) A radial grout curtain around the plug shall be formed before placing second stage concrete in order to perform additional grouting to stop excessive leakage.

(ix) Not less than 15 days after completion of contact grouting of the plug, the contractor shall carry out consolidation grouting of the surrounding rock, in accordance with the requirements of chapter - Drilling and Grouting.

13.11.3 Concrete in Caverns

(i) Where the Underground caverns or other excavations pass through loose or soft rock, which is liable to disintegrate on exposure to air or to become loose or unstable due to running water or other causes, shotcrete / backfill concrete (initial lining) and / or the concrete lining shall be provided immediately and as close to the working faces as practicable and as ordered by the Engineer so that the interval of exposure between the excavation and the lining shall be as short as possible.

(ii) The invert, sides and arches of the Underground caverns shall be cleared of all loose materials, cracked or shattered rock and then thoroughly cleaned as specified in this chapter.

(iii) Before placing of concrete is undertaken, rock surfaces shall be thoroughly wetted.

(iv) Before placing of the concrete, the contractor shall get the section / dimensions for finished or otherwise intended sizes as per approved drawings thoroughly checked by the Engineer.

(v) Placing of concrete shall not be commenced till ordered by the Engineer.

(vi) The equipment used to place concrete in lining of underground caverns shall be such as to allow concrete to be placed to the dimension shown on the drawings or as otherwise required by the Engineer in the manner as specified in this chapter.

(vii) Concrete in the lining of inverts of underground caverns shall not be placed by means of pneumatic equipment. During placement of linings and once sufficient concrete has been placed, complete filling of the arch and walls

and around and embedded item shall be ensured by keeping the end of the supply line buried in the concrete or by any other method acceptable to the Engineer.

(viii) The difference in elevation of fresh concrete in any pour shall be kept to a minimum, and the contractor shall remove loose timber and other lagging, as required by the Engineer, from steel supports to be embedded in concrete. All remaining lagging and other material shall be blocked and wedged or tightened by other means, to the satisfaction of the Engineer. All surfaces in contact with concrete shall be prepared as specified herein.

(ix) The lining of cavities shall be void filled, as shown on the drawings and as directed by the Engineer.

(x) Concrete for lining of caverns shall be pumped. The concrete may also be permitted by the Engineer to be placed by pneumatic placer. Decision as to whether a pump or a placer is to be allowed, shall rest solely with the Engineer. Method to be followed for concreting shall be got approved by the contractor from the Engineer.

(xi) After the completion of the entire work covered under this contract, the contractor shall remove all muck, shuttering, scaffolding, wood or iron scrap or rubbish of any type.

(xii) The contractor shall take sufficient care to protect, adequately, the surface or the completed work from damage. Any damage to the concrete shall be made good in such area and with such materials and method as the Engineer may so direct.

13.11.4 Backfill Concrete behind Steel Liner

(i) No windows for introduction of vibrators shall be provided in the steel liners. Working space shall be provided at the crown of the tunnel and the shaft to permit access for the necessary vibration of the backfill concrete. Special care shall be taken to ensure compaction of concrete and complete filling of the space between rock and the steel lining and filling of the crown.

(ii) Concrete used for backfilling behind the steel liner shall be of the grade as specified on the drawings or as directed by the Engineer.

(iii) Concreting shall be coordinated and carried out in conjunction with the installation of the permanent steel liner according to the following sequence:

First, concreting of the tunnel invert, including casting in of rails.

Second, Launching of the permanent steel liners. A maximum of 3 units, may be installed before the surrounding backfill concrete is placed.

Placing of the surrounding concrete by the contractor.

Installation of further steel liner units shall not proceed until either 24 hours have elapsed since placing of the backfill concrete, or the concrete has attained 20% of its required 28 days compressive strength.

13.11.5 Concrete in Shafts/Multi junction

(i) Where the underground shafts/caverns pass through loose or soft rock, which is liable to disintegrate on exposure to air or to become loose or unstable due to running water or other causes, shotcrete/backfill concrete (initial lining) and /or the concrete lining shall be provided immediately and as close to the working faces as practicable and as ordered by the Engineer so that the interval of exposure between the excavation and the lining shall be as short as possible.

(ii) Before placing of concrete is undertaken, rock surfaces shall be thoroughly wetted.

(iii) Before placing of the concrete, the contractor shall get the section/dimensions for finished or otherwise intended sizes as per approved drawing thoroughly checked by the Engineer.

(iv) Placing of concrete shall not be commenced till ordered by the Engineer.

(v) Concrete in the lining of inverts shall not be placed by means of pneumatic equipment. During placement of linings and once sufficient concrete has been placed, complete filling around any embedded items shall be ensured by keeping the end of the supply line buried in the concrete or by any other method acceptable to the Engineer.

(vi) The difference in elevation of fresh concrete in any pour shall be kept to a minimum, and the contractor shall remove loose timber and other lagging, as required by the Engineer, from steel supports to be embedded in concrete. All remaining lagging and other material shall be locked and wedged or tightened by other means, to the satisfaction of the Engineer. All surfaces in contact with concrete shall be prepared as specified herein.

(vii) The approved overbreak behind lining shall be void filled, as shown on the drawings and as directed by the Engineer.

(viii) Concrete for lining of shafts/multi-junction shall be pumped. The concrete may also be permitted by the Engineer to be placed by pneumatic placer. Decision as to whether a pump or a placer is to be allowed, shall rest solely with the Engineer. Method to be followed for concreting shall be got approved by the contractor from Engineer.

(ix) After the completion of the entire work covered under this contract, the contractor shall remove all muck, shuttering, scaffolding, wood or iron scarp or rubbish of any type.

(x) The contractor shall take sufficient care to protect, adequately, the surface or the completed work from damage. Any damage to the concrete shall be made good in such area and with such materials and method as the Engineer may so direct.

13.11.6 Concreting in Tail Race Outfall Structure

(i) While placing concrete, the exposed area of fresh concrete shall be kept as the minimum possible by first building up the concrete in successive and approximately horizontal layers to full width of a block and to full height of the lift over a restricted area at the downstream end of the block and then continuing upstream in similar progressive stages to the full area of the block The slope formed by the unconfined upstream edges of the successive layers of concrete shall also be kept as steep as practicable in order to keep its area minimum, Concrete along these edges shall not be vibrated immediately if the weather conditions are such that the concrete will harden to the extent that any vibration done later on, will fully consolidate and integrate it with more recently placed adjacent concrete. Clusters of large aggregate shall be scattered and concrete shall be vibrated completely before another deposit of concrete is placed over it.

(ii) Mass concrete shall not be placed during rains, if sufficiently heavy or prolonged, as this may result in washing away of mortar for coarse aggregate on the forward slopes of placement.

(iii) Once placement of mass concrete has commenced in a block, placement shall not be interrupted (by diverting, placing equipment to other places) till completion of such block.

(iv) Concrete shall be placed, as nearly as practicable, in its final position and shall not be piled up in large masses at any point and then pushed, shoveled, or vibrated into empty spaces for long distances. However, full capacity of concrete bucket may be deposited in one operation where this has not objectionable effects on placing of concrete , but near forms, in and around embedded metal work and elsewhere, as directed, the contents of the bucket shall be discharged in such quantities that satisfactory placement shall be secured.

(v) Concrete buckets shall be capable of promptly discharging low slump mass concrete mixes specified and dumping mechanism shall be so designed as to permit discharge of as little as ½ m^3 portion of concrete in one place. Bucket shall be suitable for attachment to and use of drop chutes where required in confined locations.

(vi) At such locations where freezing conditions are expected, richer concrete mix (higher in cement contents) shall be placed on the exposed surfaces of the mass concrete than in the interior with the approval of the Engineer.

(vii) The minimum allowable period between successive lifts of concrete in any one block shall generally be 72 hours, or as shown on the drawings or as directed by the Engineer.

(viii) The height of a lift shall vary from 1.5m to 2.25m or as shown on the drawings or as directed by the Engineer.

(ix) During placement, the concrete shall fall vertically and shall be discharged fast enough to form a cohesive, bulging and growing mass without separation as the concrete is discharged by the concrete placing buckets.

(x) Areas adjoining embedded materials shall be consolidated with manual vibrators.

13.11.7 Concrete in RCC Frames/Walls/Slabs

(i) Concrete shall be placed in lifts of heights as shown on the drawings or as directed by the Engineer. Within each lift, concrete shall be deposited in approximately horizontal layers about 40cm in thickness unless otherwise directed by the Engineer.

(ii) At locations where lift heights are not shown on the drawings, the contractor shall submit to the Engineer for approval, details of the placing procedure he proposes. No concrete shall be placed at such locations without the prior approval of the Engineer.

(iii) Slabs shall be placed in one lift unless otherwise indicated or directed by the Engineer.

(iv) In walls, lifts shall terminate at such levels as will conform to the structural requirements.

(v) The placement of concrete shall be carried out at such a rate and in such a manner that the formation of cold joints is prevented.

(vi) Where slabs and beams are placed continuously with walls and columns, the concrete in walls and columns shall have been in place for at least 2 hours or for a longer period when so directed by the Engineer before placing concrete in the slabs and beams.

13.11.8 Concrete for Blockouts

(i) Blockouts for gate guides, seals or track assemblies of the like shall be provided as indicated on the drawings.

(ii) After the assemblies have been installed and adjusted, the blockout recesses shall be filled with concrete as specified on the drawings or as directed by the Engineer.

(iii) Before installing the components to be embedded in blockout concrete and before depositing mortar or concrete, the concrete surfaces of the blockout shall be cleaned in the manner specified for cleaning construction joints.

(iv) Exceptional care shall be taken in placing mortar or concrete in the blockouts to ensure satisfactory bond with the concrete previously placed and to secure complete contact with all components embedded in the blockouts.

13.11.9 Concrete Deposited in Water

(i) Concrete shall be deposited in water only with the prior approval of the Engineer.

(ii) Concrete placed underwater shall be deposited by a tremie or by a valved tremie.

(iii) The methods and equipment used shall be subject to the prior approval of the Engineer

(iv) Concrete buckets shall not be permitted for underwater placement of concrete.

(v) The tremie seal be affected in a manner which will not produce undue turbulence in water around the pipe. The discharge end shall be kept submerged continuously in the concrete and the concrete pumped in without interruption until the concrete has been brought to the required height.

(vi) The tremie shall not be moved horizontally during a placing operation and a sufficient number of tremies shall be provided so that concrete does not have to flow horizontally, a distance of more than 3 meters.

13.12 Chipping and Roughening of Concrete Surfaces.

(i) Surface upon or against which additional concrete is to be placed shall be chipped and roughened to a depth of not less than 25mm.

(ii) The roughening shall be performed by chipping, sand blasting or other satisfactory methods and in such manner as not to loosen, crack or shatter any part of the concrete beyond the roughened surface.

(iii) After being roughened, the surface of the concrete shall be cleaned thoroughly of the loose fragments, dirt and other objectionable substances and shall be sound and hard and in such condition as to assure good mechanical bond between old and new concrete.

(iv) All concrete which is not hard, dense and durable shall be removed to the depth required to secure a satisfactory surface.

13.13 Defective and Damaged concrete.

Concrete which is damaged from any cause and which is not manufactured, placed and compacted in accordance with these specifications and is found to have lower strength, density etc. than specified, as determined from test samples or core samples, shall be removed and replaced by the contractor.

13.14 Finishing of Concrete

13.14.1 Finishing of Formed Surfaces

Except as otherwise specified or directed, all permanently exposed concrete surfaces and other waterway surfaces requiring durability under water shall be finished in the following manner:

(i) Any damage to finished concrete resulting from the action of removing formwork or from any other cause shall be repaired to the satisfaction of the Engineer. Immediately on removal of the form, the surface shall be examined and all porous honeycombed or defective concrete removed and repaired as specified herein.

(ii) All imperfections or ridges due to joints in the formwork, shall be removed by light chipping or grinding down if necessary, to produce a smooth surface.

(iii) When the treatment of a surface has been completed, the surface shall be cured.

(iv) All patches and mortar filled pits on exposed surfaces shall be neat and of the same colour and texture as the adjoining concrete.

(v) The finished surfaces of concrete shall be true, sound, smooth and free from fins, offsets, pits, depressions, voids, blemishes and other defective concrete and surface irregularities and shall be in accordance with the requirements for the particular class of finish specified herein or as shown on the drawings.

(vi) Finishing work shall be done only by skilled workman in the presence of the Engineer and shall be performed within 4 weeks of placing.

(vii) Before final acceptance of the work, contractor shall clean all exposed concrete surfaces of all encrustations of cement, mortar or grout, to the satisfaction of the Engineer. Concrete shall not be considered finished until all required repair work and finishing have been completed.

13.14.2 Finishing of unformed surfaces

Unformed surfaces shall be finished by one or more methods of screeding, floating and trowelling and working of the surfaces shall be done at the proper time, employing experienced men and shall be just sufficient to produce the desired finish.

(i) Screeding

(a) It gives the surface its approximate shape by striking off surplus concrete immediately after completion and shall be accomplished by moving a straight edge or template with a swing motion across wood or metal strips which have been established as guides.

(b) Where the surfaces are curved, a special screed shall be used.

(ii) Floating

Shortly after the concrete is screeded, the surfaces shall be brought true to form and grade by working it sparingly with a wooden float. If a coarse textured finish is specified or if the surface is to be steel trowelled, a second or final floating shall be performed after some stiffening has occurred and the surface moisture film or shine has disappeared.

(iii) Trowelling

(a) If a smooth dense finish is desired, floating shall be followed by steel trowelling some time after moisture film or shine has disappeared from the floated surfaces and when the concrete has hardened sufficiently to

prevent fine material and water from being brought upto the surface. Excessive trowelling at an early stage as would tend to produce cracking or result in a surface that is too hard to finish properly shall be avoided.

(b) Trowelling shall, therefore, be done at the appropriate time and shall have the surface smooth, even and free of trowel marks and ripples. A fine textured surface that is not slick shall be obtained by trowelling lightly over the surface with a circular motion keeping the trowel flat on the surface of the concrete. Where a hard steel trowelled finish is required, trowelling shall be continued until it no longer produces noticeable compaction and the surface has a glossy appearance, trowelling pressure being increased gradually as the operation progresses.

(c) The use of any finishing tool in areas where water has accumulated shall be prohibited. Operation on such areas shall be delayed until the water has been absorbed or has evaporated or has been removed by draining, mopping or other means.

(d) All joints and edges on unformed surfaces, that shall be exposed to view, shall be finished with suitable moulding tools with rounded, bevelled or filleted edge, as directed by the Engineer. Unless the use of other slopes or level surfaces is indicated on the drawings as directed, narrow surfaces such as top of walls or tunnel portals shall sloped approximately 9mm per 300 mm of width. Boarder surfaces as walls, roadways, platforms and decks shall be sloped approximately 6 mm per 300 mm.

(e) Where separate floor finish is specified or directed, the concrete shall be struck of sufficiently below grade to allow for the subsequent placing of a finished floor. The surface of such concrete shall be left rough.

(f) As soon as the condition of the base permits and before it has hardened fully, all dirt, laitance and loose aggregate shall be removed from the surface, by means of water jets and wire brooms leaving the coarse aggregate slightly exposed and the surface made suitable for taking further concrete.

13.14.3 Tolerance for Concrete Construction

(i) General

(a) The contractor shall construct all concrete structures to the exact lines, grades and dimensions shown on the drawings. However, inadvertent variations for the established lines, grades and dimensions shall be permitted to the extent set forth herein, provided, that the Engineer reserves the right to diminish the tolerances set forth herein if such tolerances impair the structural action or operational function of the structure.

(b) Where tolerances are not stated in the specifications or on the drawings for any individual structure or features thereof, permissible deviations shall be interpreted in conformity with the provisions of this paragraph.

(ii) Tolerance for concrete in underground overbreak/Tunnels etc.

The concrete in underground overbreak & tunnels shall conform to the tolerances as per Indian standards or equivalent International Standards or as directed by the Engineer. In general these tolerances shall be as under:

(a) The inclination of the tunnel invert can differ only 0.1% (10cm per 100m) from the design inclination, the accumulated vertical deviation of the springline from the theoretical shall not exceed 20cm in total. The horizontal deviation shall be within a limit of ± 20 cm.

(b) Gradual variations measured with 1.5m template shall be 12mm.

(c) Abrupt variation in the direction of flow shall be 6mm and that across the flow shall be 3mm.

(d) Variation in thickness of lining shall be minus zero.

(iii) Tolerance for surface Finishes

(a) Surface finishes shall generally conform to the types and tolerances indicated in the table given below, unless otherwise specified on the drawings or as required by the Engineer.

(b) Variation in thickness of concrete lining for underground work i.e., cavities/tunnels shall be minus zero.

(c) Positive tolerance shall be measured outside and negative inside the lines and grades defining the structure on the drawings.

Type of Finish	General Area of Application and method of forming	Tolerance (mm)
F1	Formed surfaces of construction joints and other surfaces which shall not be permanently exposed. The surface shall require no treatment after form removal, other than repair of defective concrete and specified curing, or treatment as specified for construction joints.	+10 -10
F2	All permanently exposed formed surfaces for which type F3 finish is not specified. Form sheathing or lining shall be placed so that joint marks on the concrete surface shall be in general alignment, both horizontally and vertically and conform to a standard pattern. Immediately on the removal of forms, all unsightly ridges of fines shall be removed; all holes left by removal of ends of form rods shall be neatly filled with mortar and surfaces treated to meet the required tolerances by tooling and rubbing.	+5 -5
F3	Formed surfaces which shall be exposed to flowing water shall be hard, smooth and dense, free from offsets, pits, voids, air holes and irregularities, and shall be chipped, ground and thoroughly cleaned as necessary to conform to the required tolerances.	+5 -5
U1	Unformed, screeded surfaces which shall be covered by fill materials, static water or concrete. Type U1 finish shall be used as the first stage of type U2 and U3 finishes. Finishing shall consist of sufficient levelling and screeded to produce an even, uniform surface meeting the required tolerance.	+10 -10
U2	Unformed surfaces not permanently concealed by fill or concrete or not required to receive type U3 finish. (Type U2 finish shall be used as the second stage of Type U3 finish). Floating by means of hand or power driven equipment shall be started as soon as the screeded surface has stiffened sufficiently and shall be the minimum necessary to produce a surface that is free from screed marks and uniform in texture if type U3 finish is to be applied, floating shall be continued until a small amount of mortar without excess water is brought to the surface so as to permit effective trowelling.	+5 -5
U3	Unformed, screeded surfaces which shall be exposed to flowing water. This finish shall be applied by steel trowelling after the concrete has hardened enough to prevent excess of fine materials and water from being brought to the surface free from blemishes, ripples and trowel marks. After the surface has nearly hardened, it shall be trowelled once more until the surface is hard and glossy in appearance.	+3 -3

13.15 Curing and Protection of Concrete

(i) Plant and materials required for curing and protection of concrete shall be available at the location of each concrete placement before concrete placement is started and the water used for curing shall meet the requirements set out in Chapter - Materials for Construction of these documents.

(ii) All concrete shall be protected against injury until final acceptance.

(iii) Exposed finished surfaces of concrete shall be protected from the direct rays of the sun for atleast 72 hours after placement.

(iv) Fresh exposed concrete shall also be protected from the action of the rains, flowing water and mechanical injury.

(v) No fire shall be permitted in direct contact with concrete at any time.

(vi) Concrete in which ordinary portland cement is used shall be kept continuously moist for not less than 14 days, for normal concrete and 21 days for concrete containing pozzolana, by covering with water saturated materials or a system of perforated pipes, mechanical sprinklers or porous hose or by any other approved method. Curing period where special cement may be used shall be specified by the Engineer.

(vii) Construction joints shall be cured in the same manner as the other concrete and shall also, if practicable, be kept moist for atleast 72 hours prior to the placing of additional concrete upon the joint.

(viii) Horizontal surfaces shall be cured by sprinkling water or by covering with damp sand or may be cured by the use of wet quilts or mats which will satisfactorily supply the required curing water. If damp sand bag or quilt is used for curing, it shall later be completely removed. The time of applying damp sand shall be specified by the Engineer before which curing shall be carried out by other approved methods.

(ix) The method of keeping formed concrete surface moist shall be continuous sprinkling or spraying of water as may be necessary to prevent any portion of the surface from drying during the specified period.

(x) The water and other methods of curing shall be so handled as not to stain concrete surfaces, which shall be exposed.

(xi) The actual method of curing adopted shall be subject to the approval of the Engineer.

(xii) The contractor shall have on hand and ready to install before actual concrete placement is started, all equipment needed for adequate curing and protection at all locations of concrete placement.

(xiii) In limited areas and for special purposes, the use of an approved and properly applied compound may be permitted at the discretion of the Engineer to restrict the evaporation of the mixing water. Such curing compound shall be of the surface membrane type which will thoroughly seal

the surface. Curing compound shall not be used on joints where bonding is required.

(xiv) Curing compounds shall be applied according to the manufacture's recommendations to provide a continuous uniform membrane over all areas. Curing compounds shall be applied only after moist curing has been carried out for atleast 24 hours.

(xv) A curing compound shall not be used on any unformed surface where, in the opinion of Engineer, the irregularities in that surface would prevent the membrane forming an effective seal, on any surface which has a temperature lower than manufacturer's recommended application temperature, or any surface where a bond is required for additional concrete, or where a curing compound is placed on a surface where a bond is required, it shall be removed by sand blasting or by other means satisfactory to the Engineer.

(xvi) Curing membrane shall be protected from damage at all times.

(xvii) Care shall be taken not to disturb the steel reinforcement projecting from any placement for at least 24 hours after the completion of such placement.

(xviii) Finished concrete surface shall be protected from stains or abrasion and surface or edges likely to be injured during the construction period shall be kept properly protected by leaving forms in place or erecting protective covering satisfactory to the Engineer.

(xix) In case, the curing operations are inadequate or unsatisfactory, the Engineer shall be entitled to take such steps as he may deem necessary to make good the deficiencies and defects.

13.16 Repair of Concrete

13.16.1 General

(i) Repair of concrete shall be performed by skilled workman and in the presence of the Engineer.

(ii) No repair work shall be carried out until the Engineer has inspected the location of the proposed repair and accepted the method of repair.

(iii) The contractor shall correct all imperfections on the concrete surfaces as necessary to produce surfaces that shall conform to the required standards.

(iv) All materials, procedures and operations used in the repair of concrete shall be subject to approval by the Engineer.

(v) Surfaces of concrete finished against forms shall be smooth and free from projections. Immediately upon the removal of forms and within 24 hours thereof, wherever, practicable, all unsightly ridges or fines shall be removed and any local bulging on exposed surfaces shall be remedied by tooling and rubbing. All holes left by the removal of fasteners from the tie rods shall,

after being reamed with a toothed reamer, be neatly filled with dry pack mortar.

(vi) All honey combed, porous, fractured or otherwise defective concrete and surface concrete in which, in the opinion of the Engineer, additions are required to bring it to the prescribed lines, shall be removed by chipping concrete.

(vii) The chipped openings shall be sharp edged and keyed, and shall be filled to the required lines with fresh concrete or as found suitable. Where concrete is used for filling, the chipped openings shall be not less than 100mm in depth and the fresh concrete shall be reinforced and dowelled to the surface of the openings as directed by the Engineer

(viii) Dry pack mortar shall consist of one part of cement to two parts of sand by volume and just enough water so that the mortar as used sticks together on being moulded into a ball by slight pressure of the hands and does not free water when so pressed but leaves the hands damp. The mortar shall be fresh when placed and any mortar that is not used within 30 minutes, after preparation shall be wasted with all consequences to the contractor.

(ix) The mortar shall be placed in layers not more than 25mm thickness after being compacted and each layer shall be thoroughly tamped to the satisfaction of the Engineer. Each layer except the last shall be roughened thoroughly to provide effective bond with the succeeding layers. The last or finishing layer shall be smoothened to form a surface continuous with the surrounding concrete. Dry pack mortar shall be used for filling behind reinforcement or for filling holes that extend completely through a concrete section. Shotcrete shall be used for holes too wide for dry pack mortar filling and too shallow for concrete filling and no deeper than the far side of the reinforcement that is nearest to the surfaces.

(x) All patches shall be bonded thoroughly to the surface of the chipped openings and shall be sound and free from shrinkage cracks and trummy areas.

(xi) Concrete surfaces where high velocity flows may occur and as required by the Engineer, repair to the surfaces having F3 and U3 finishes shall bonded with an epoxy adhesive acceptable to the Engineer.

(xii) All repairs to the surface of concrete for flowing water shall be ground smooth to meet the tolerances set out in para 13.14.3 of these specifications.

13.16.2 Sealing Work in Structural Concrete of Underground Structures.

(i) The contractor shall carry out sealing work to reduce water inflow and water losses through, and to guarantee the normal water tightness of the concrete lining of underground structures according to criteria stated hereafter and as requested by the Engineer.

(ii) The work shall consist of sealing the cold joints, construction joints, shrinkage cracks both vertical and horizontal, honeycombs and poorly

grouted or sealed grout holes. The work shall be performed intermittently, whenever water inflows are observed and measured, wide cracks are discovered or the future impermeability is, in the judgement of the Engineer, doubtful.

(iii) The sealing work shall be carried out when following phenomena are encountered;

(a) Cracks or joints of width greater than 0.20mm regardless whether they are dry or wet.

(b) Areas of porous concrete (e.g., due to poor vibration) of which depth is obviously deeper than superficial.

(c) Grout holes filled only with cement/ water mix.

(iv) The sealing work shall be executed as under:

(a) Crack or joint 0.2-0.6mm wide shall be repaired as stipulated in Chapter “Drilling and Grouting”.

(b) Crack or joint wider than 0.6mm shall be repaired as under (a) above, followed by cutting a groove 25mmx25mm along the joint or crack and subsequent filling with an epoxy mortar.

(c) Areas of porous concrete shall be grouted under high pressure (30 bar) with cement grout mix w/c=0.7 by weight, containing a water reducing air-entraining admixture. Grout holes shall be drilled at 50cm spacing upto the rock. After grouting, the area shall be repaired with epoxy mortar.

(d) Grout holes filled only with water / cement mix shall be redrilled upto 2/3rd of the theoretical lining thickness and filled with dry-pack mortar.

13.17 Construction Joints

(i) Concrete surfaces, which become so rigid, by reason of limitations in the rate of placing of concrete imposed by theses specifications or by reason of delays in construction progress, that in the opinion of the Engineer, the new concrete cannot be integrally incorporated with that previously placed, shall be defined as construction joints.

(ii) Construction joints shall be located in the positions shown on the drawings or as directed by the Engineer and the contractor shall not be permitted to make any additional joints or deviate from the joints indicated on the drawings without the written authorization of the Engineer.

(iii) Joints at exposed surfaces of concrete shall be straight and continuous, as shown on the drawings or otherwise directed.

(iv) The concrete of the earlier pour shall be hacked to produce a rough surface or green cut with air-water jet or by sand blasting after the concrete has hardened sufficiently as directed by the Engineer. Before placing new concrete, the surface shall be restored to the condition existing immediately

after hacking or green cutting by means of another washing with air-water jet, vigorous brushing, sand blasting etc.

(v) All the joints shall be cleaned by the contractor to the satisfaction of the Engineer. All intersections of construction joints with concrete faces, which will be exposed to view shall be made straight, level and in plumb.

(vi) All exposed construction joints shall conform to the requirements of aesthetics and their pattern shall be subject to the approval of the Engineer. Surfaces of the construction joints which have been permitted to dry by reason of the succeeding layer not placed with the specified moist curing period, shall be kept moist for alreast 72 hours prior to placing the succeeding layers.

(vii) Horizontal construction joints shall be arranged wherever possible to coincide with joints in the formwork.

(viii) To prevent feather edges, the construction joints at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface so that the angle between such inclined surface and the exposed concrete surface shall not be less than 50 degrees.

(ix) When the work has to be resumed on a surface which has hardened, such surfaces shall be roughened and new concrete placed after taking all measures mentioned at sl. no. (v) para 13.10.3 hereof.

(x) The use of a retarder shall not relieve the contractor of the responsibility of producing surfaces at construction joints as specified and to the satisfaction of the Engineer.

(xi) Disturbance of surface concrete at the joints shall be avoided during the early hardening period. Before placing the succeeding layer, the surface of the construction joint shall be thoroughly cleaned and loose, defective or fractured concrete shall be removed satisfactorily.

13.18 Expansion and Contraction Joints

(i) Expansion and contraction joints shall be constructed at such points and of such dimensions as indicated on the drawings or as required by the Engineer. The method and material used shall be subject to the approval of the Engineer.

(ii) Standard bitumen sheets, impregnated with saw dust or any other filler material and sealing compounds, required to be placed in the expansion joints, shall be fixed in position as shown on the drawings or as directed by the Engineer.

13.19 Embedments in Concrete/Rock

13.19.1 Anchor Bars

(i) Wherever indicated on the drawings or directed by the Engineer, holes shall be drilled into rock to receive bars for anchoring to the rock, concrete or masonry structures or parts, thereof.

(ii) The type and dimensions of the anchors bars, locations, diameter and depths of anchor bar holes shall be as shown on the drawings or as directed.

(iii) Anchor rods shall be thoroughly cleaned before being placed in the drill hole. The hole shall be filled with grout. The grout shall be a workable 1:1 sand / cement mix with low water cement ratio. Admixture for fast setting and low shrinkage may also be required.

(iv) Wherever practicable, anchors shall be installed before the concrete is placed, except when otherwise provided or permitted.

(v) Drilling for the installation of anchors in the concrete shall not be carried out except with the prior approval of the Engineer.

(vi) Where the installation of anchors prior to placing of the concrete, is not practicable, satisfactory formed openings shall be provided or holes drilled for the purpose and the anchors grouted in the openings at some later date.

(vii) In the case of reinforced concrete foundations, anchor bolts for machinery may be placed in approved pipe sleeves to facilitate machinery installation and the sleeve shall be completely filled with grout or mortar as directed by the Engineer. The exact method adopted shall be subject to the prior approval of the Engineer.

(viii) The anchors shall be protected against disturbance for a minimum time of 48 hours after installation or more as required by the Engineer.

13.19.2 Embedded Parts

(i) Before placing concrete, care shall be taken to ensure that all embedded parts are firmly and accurately fastened in place as indicated on the drawings or as directed.

(ii) All embedded parts shall be thoroughly cleaned, free from all foreign matter such as scale, rust, oil etc.

(iii) The contractor shall place concrete in embedded part after these have been checked and approved by Engineer. However the responsibility of accuracy in placement thereof shall remain with the contractor.

(iv) Parts of gates, gate hoists, valves, operating machines and other control equipment as also the anchor bolts, structural shape plates and bearings required in connection with the installation of these parts will be supplied to the contractor by the Engineer. These parts shall be installed/embedded in concrete/rock by the contractor as shown on the drawings or as directed.

(v) If concrete is placed by the contractor without correctly placing in position, the necessary embedded parts, concrete shall have to be removed and replaced by him to enable such embedded parts to be installed in position, without any extra payment to him.

(vi) Care shall be taken not to disturb or displace embedded parts during concrete placement.

13.19.3 Waterstops

(i) Polyvenyl chloride (PVC)/rubber waterstops of width and section as given in the Bill of Quantities or as shown on the drawings shall be furnished and installed for water tight construction at various locations of concrete structures/ components covered under these specifications. In order to ensure proper alignment and fixing of waterstops in correct position / place, the same shall be rigidly secured to the formwork or reinforcement steel as directed / approved by the Engineer. Number of joints in PVC / rubber waterstops, when installed in place, shall be the barest minimum and joints, thus made, shall be suitably vulcanised / welded by the use of best method / engineering practice satisfactory to the Engineer.

(ii) All types of waterstops shall be tested in a recognized laboratory prior to transport to the site. Test specimens shall be furnished by the manufacturer and the tests shall be carried out at the manufacturer's place.

(iii) Waterstop shall be tested as to their tensile strength, elongation, duration, water absorption, specific gravity, effect of alkali and impact resistance.

13.19.4 Pressure Relief Valves

(i) Pressure Relief Valves shall be installed by the contractor as shown on the drawings or as directed by the Engineer.

(ii) Care shall be taken by properly checking all the joints, if any, to prevent leakage, when embedded in concrete.

(iii) Valves shall be placed accurately and held securely in position so as not to be displaced when the concrete is placed.

(iv) Special care shall be exercised to ensure that the bottom of the valve in contact with the concrete / filter is suitably protected against clogging as directed by the Engineer.

(v) Pressure Relief Valves will be supplied by the Engineer.

13.20 Measurements and Payments

13.20.1 Concrete

13.20.1.1 General

(i) Measurement for payment for each grade of concrete will be volume of concrete placed within the lines, grades and pay limits shown on the drawings.

(ii) Payment will be made at the Unit Rate for different grades and types of concrete entered in the Bill of Quantities, which shall include, but not be limited to, the following:

(a) Excavation, loading, transportation, crushing, screening, washing, blending and storage of aggregates.

(b) Batching, supply of mixing water, mixing, transportation, placing and compaction of concrete.

(c) Labour, tools and equipment for cleaning and preparing surfaces prior to concreting.

(d) Forming and treatment of construction joints including furnishing and spreading of mortar layers before concrete placing.

(e) Surface finishing.

(f) Attaining the concrete temperature as specified, and following hot and/or cold weather precautions.

(g) Protection and curing of concrete.

(h) Repair of defective concrete, all types of cracks and sealing of joints and removal of rejected concrete.

(i) Communication system connecting the points of placing concrete with the relevant mixing plant or delivery equipment.

(j) Furnishing samples of materials i.e., cement, coarse and fine aggregates, water, admixtures as also the samples of concrete, mortar and providing assistance for sampling required in connection with the tests to be performed jointly by contractor and Employer.

(k) Chipping and roughening of concrete surfaces.

(l) Testing of concrete.

(iii) Unless otherwise stated, no payment will be made for concrete placed outside these limits, other than in additional excavation directed by the Engineer, and the measurement shall not include any filling of overbreak unless recognized as due to the geological conditions conforming to the limits defined in other chapters of these specifications

(iv) All associated concrete work, such as removal of forms and repairs and finishing of concrete shall be completed as soon as practicable after concrete is placed. Concrete will not be considered for payment until all associated works have been completed to the satisfaction of the Engineer.

(v) Measurement for payment and payment for formwork and steel reinforcement are stipulated in other Sections of these Specifications.

13.20.2 Tunnel/Shaft Concrete Lining

(i) Measurement for payment for concrete placed in the tunnel/shaft lining and in the access adit(s) lining will be volume of concrete placed upto the pay line. Deductions from this volume will be made for the in-situ concrete or shotcrete placed earlier, which will be paid for separately in term of relevant provisions of contract. The volume to be deducted will be calculated as area multiplied by the average layer thickness established by an approved method.

(ii) Payment will be made at the appropriate Unit Rate per m^3 entered in the Bill of Quantities for different grades of concrete.

(iii) The Unit Rates shall include, in addition to the works described under para 13.21.1, the entire cost of the following:

(a) Design, furnishing, maintenance, erection, and removal of steel formwork.

(b) Pumping of the concrete.

(c) Contact grouting materials and placing grout in the crown of the tunnel, shaft and cavern.

(d) Sealing of cracks, cold joints etc., where directed by the Engineer.

(e) Provision and installation of thermocouples for temperature measuring.

(f) M-10 grade of Concrete in unapproved overbreaks in tunnel overt.

(g) Concrete beyond Pay Line in the invert of tunnel/adit (Overbreak in the invert are not recognised) except extremely poor rock.

(iv) Concrete in the invert of Adit as per thickness of concrete specified in the construction drawing will be paid separately as per rate entered by him in the Bill of Quantities. However, maintenance and operation of Adit invert and side drains will be done by the contractor at his own cost during construction period. The contractor shall ensure to keep Adit invert dry at his own cost.

13.20.3 Backfill concrete in approved overbreaks in Underground Excavation.

The payment will be made for backfill concrete placed in approved overbreaks and following conditions shall apply:

(a) Concrete placed simultaneously with concrete for the tunnel structural lining will be paid at 75% (seventy five percent) of the Unit Rate for Structural concrete lining. The payment for cement variation and admixture used for such backfilling shall also be made at 75% (seventy five percent) of the Unit Rate entered in BoQ.

(b) Concrete (M10) placed for backfilling of approved overbreaks behind steel ribs will be paid at the Unit Rate for (M10) entered in the Bill of Quantities.

13.20.4 Backfill Concrete in Open Excavation

(i) Where backfilling with concrete is directed by the Engineer, payment will be made for concrete placed as backfill in dental excavation and in additional excavation directed by the Engineer.

(ii) Payment will be made at the Unit Rate per m^3 entered in the Bill of Quantities for backfill concrete of the appropriate grade as shown on the drawings or as directed by the Engineer.

13.20.5 Backfill Concrete Behind Steel Liner

(i) Measurement for payment for M-20 grade of concrete placed behind steel lining will be of the volume of concrete placed upto payline as shown on the drawings. Deduction from this volume will be made for the insitu concrete or shotcrete placed, which will be paid for separately. The volume to be deducted will be calculated as area multiplied by the average layer thickness established by an approved method.

(ii) Payment will be made at the appropriate unit rates per m^3 entered in the bill of quantities which shall include, in addition to the works described under para 13.20, the entire cost of contact grouting materials and placing grout in the crown of tunnel and shaft and pumping the concrete.

13.20.6 Concrete Plug in Adit(s)/Diversion Tunnel

(i) In addition to the Works described under Para 13.20, the entire cost of labour and material related to crown contact grouting shall also be included in the Unit Rates entered in the Bill of Quantities for concrete plug in the adit (s)./diversion tunnel.

(ii) In addition to the works described under para 13.20, the entire cost of labour and material related to cooling system and contact grouting between the plug concrete and tunnel lining concrete, construction joints, grouting and drainage pipes fill grouting shall also be included in the Unit Rate entered in the Bill of Quantities for concrete plug.

(iii) Consolidation grouting of the surrounding rock shall be measured for payment and payment will be made as stipulated in chapter "Drilling and Grouting".

(iv) Concrete for Access Adit(s) plug will be paid as per rate entered in the BOQ.

13.20.7 Second Stage Concrete and Concrete in Blockouts for Embedding of Equipment

(i) Measurement for payment of second stage concrete and concrete in blockouts will be of the volume of placed concrete. Only second stage concrete placed in spaces exceeding 0.10 m^3 in volume or 0.05 m^2 in cross section will be considered for payment. Second stage concrete placed in blockouts or spaces less than those stated above shall be deemed to be included in the Unit Rate for concrete in the structure with which it is associated.

(ii) Payment will be made at the Unit Rate per m^3 entered in the Bill of Quantities, which shall include, in addition to the works included under para 13.20, the entire cost of preparation of contact surfaces with parent concrete, furnishing of nonshrink agent where directed and any other related work.

13.20.8 Grouting of Equipment Bearing Plates and Anchors

Grouting of the equipment bearing plates and anchors will not be paid separately and the cost thereof, including materials, shall be included in the Unit Rate for concrete in the structure with which it is associated.

13.20.9 Waterstops

(i) Measurements for payment and payment for waterstops will be made at the Unit Rate per meter of the waterstops provided in the Bill of Quantities including cost of furnishing, fixing in place, lapping / vulcanizing and jointing.

(ii) Measurement for payment and payment for providing bitumen sheets or any other filler material for expansion and contraction joints, fixing and placing them in position will be made at appropriate Unit Rates per m^2 provided in the Bill of Quantities.

(iii) Measurement for payment and payment for joint sealing compound will be made at the appropriate Unit Rates per linear meter length as provided in the Bill of Quantities.

(iv) Painting of surfaces of expansion and contraction joints with bituminous paints will be paid at the appropriate Unit Rates per m^2 provided in the Bill of Quantities.

(v) Additional joints for contractor's convenience may be approved by Engineer, but no payment will be made for such joints.

13.20.10 Embedments in Concrete/Rock

(i) Anchor Bars

(a) The cost of grouting the anchor bar will be included in the Unit Rate for each bar diameter per meter entered in the Bill of Quantities.

(b) The anchor bar will be paid for each bar diameter at the Unit Rate per meter entered in the Bill of Quantities.

(c) The drilling of holes in rock / concrete will be paid at the Unit Rates provided in the Bill of Quantities for drilling of holes.

(ii) Embedded parts

(a) Parts of gates, gate hoists, valves, operating machines and other control equipment as also the anchor bolts, structural shape plates and bearings required in connection with the installation of these parts will be supplied to the contractor, free of cost, by the Engineer.

(b) The above parts shall be installed / embedded in concrete / rock by the contractor and will be paid for by weight at the Unit Rates provided in the Bill of Quantities.

(iii) Pressure Relief Valves

(a) The pressure Relief Valves will be supplied to the contractor, free of cost, by the Engineer.

(b) Payment for the installation of these valves will be made at the Unit Rates for each valve provided in the Bill of Quantities.

13.20.11 Cement

(i) The Unit Rates for various grades of concrete as specified in para 13.5.1 shall include the cost of the cement contents specified therein.

(ii) The payment for increase or decrease in the cement contents of the original concrete mix(s) on which the bid price has been based and the mix(s) finalized after trial mix stage will be made/recovered at the Unit Rates per kg. as provided in the Bill of Quantities.

(iii) Any variation in the cement contents beyond those specified at Sl. No.-(ii) of this para shall be to the account of the contractor.

(iv) No measurement for payment or payment will be made for cement used for:

(a) contractor's own convenience,

(b) Used for defective and wasted concrete,

(c) Concrete placed outside of the concrete paylines (e.g. for filling the overbreak other than approved overbreak due to geological conditions) or required as a result of careless excavation.

(d) Concrete produced with overuse of admixture.

13.20.12 Admixtures

(i) Measurement for payment for air-entraining and water reducing/set controlling or any other approved admixtures / additives will be of the weight of the agreed dosages established at trial mix-stages or the approved modifications thereof, for different grades of concrete, and computed on the basis of the number of cubic meters of concrete measured and approved for payment.

(ii) Payment will be made at the applicable Unit Rate per kg entered in the Bill of Quantities, which shall include the entire cost of supply, handling, storage and dispersing.

(iii) Payment will be made for Admixtures of concrete such as accelerators, plasticizers, superplasticizers, nonshrink agents (except for second stage concreting) and antifreeze admixtures for the quantities as per approved mix design. No payment will be made for admixtures used by the contractor for his own convenience.

13.20.13 No Measurement for Payment or Payment will be made for the Following:

(i) Any rounded or bevelled edges, fillets, scoring, chamfers, or any deduction made for voids or embedded items which are either less than 0.10 m^3 in volume or 0.05m^2 in cross section. No allowance will be for approved temporary openings, drains, embedded pipes, or recesses created by the contractor for his own convenience during construction provided they are filled as directed.

(ii) Collecting of seepage water or water inflow from rock surfaces and diverting it into the drainage systems as specified in Chapter-“Dewatering, Drainage and Pumping”.

(iii) Any defective and wasted concrete, concrete which has to be removed and replaced due to contractor’ noncompliance with the specifications or Engineer’s directions and all related cost shall be at the contractor’s expense.

(iv) Any concrete which the contractor places or uses for his own installations or for his own convenience.

(v) Developing alternative sources of aggregates by the contractor and the resulting additional material testing.

(vi) Pumping of the concrete and admixtures.

(vii) Any precast and precast-prestressed concrete units damaged by improper storing, handling or transportation.

(viii) Any replacement or repair of concrete damaged by blasting carried out by the contractor.

(ix) Making stockpiles for coarse and fine aggregates.

(x) Removal and replacement of any concrete placed without the prior knowledge and agreement of the Engineer.

(xi) Removal and replacement of concrete not manufactured, placed and compacted in accordance with these Specifications.

(xii) Curing compound and all operations involved in its use.

(xiii) Forming expansion and contraction joints including making drainage and other holes where such joints occur.

(xiv) Filling of holes left by the removal of concrete cores with the concrete of the same grade.

(xv) In case, when no air entraining agent is required to be used, and extra volume of cement/concrete being poured in place of air entraining agent.

(xvi) Cooling of concrete irrespective of temperature

(xvii) Formwork utilized in approved/unapproved overbreak.

(xviii) The payment for increase or decrease in the aggregate contents of the original concrete mix(s) on which the bid price has been based and the mix(s) finalized after trial mix stage will be not be made.

(xix) Payment for drilling of holes in concrete for taking out cores for testing purposes.

CHAPTER – 14
DEWATERING, DRAINAGE AND PUMPING

INDEX

14.1 Scope of work

(i) The specifications described here-in-under related to the work of dewatering, drainage and pumping to be carried out by the contractor, which shall include supply of all labour, construction plant and materials and performance of all services required to remove service water and natural surface flow or groundwater seepage from the working areas on the surface as well as from the underground sites for the construction of various structures covered under this contract.

(ii) The contractor shall design, build, install, operate, maintain and remove all the temporary dewatering facilities as specified herein or as required by the Engineer.

(iii) The work shall be executed in accordance with the contractor's designs, Specifications and sequences as approved by the Engineer.

(iv) The contractor shall be responsible for maintaining work sites free of water at all times. contractor shall make good any damage whatsoever caused by flooding of the work sites due to failure of equipment, improper maintenance of protective works, and acts of negligence in his performance of the Work. The contractor shall indemnify Employer against claims arising out of any such failure, made by other contractors, land holders or other persons.

14.2 Submittals

(i) Within 30 days after the date of issue of the Letter of Acceptance, the contractor shall submit, to the Engineer, the detailed design of dewatering system.

(ii) This design shall include the following:

(a) Design assumptions and calculations.

(b) Layouts of diversion and drainage facilities,

(c) Layout and capacity of pumps and pipes, sumps, drains both open and covered, well points etc. and details of standby dewatering arrangements.

(d) Any other arrangements or installations, the contractor may propose for dewatering of the working areas both in open and underground construction sites.

(e) Proposal for treating polluted water either by settling basins, filters, traps for separating silt or any other suitable method,

(iii) At least 30 days prior to the scheduled construction of the particular work, the contractor shall submit, to the Engineer, full details of the equipment to be installed and all necessary construction details required for dewatering purposes including geothermal water.

(iv) The Engineer reserves the right to require any additional information deemed necessary to be included in the submitted documents.

14.3 General

(i) Dewatering of the surface as well as the underground construction sites shall be undertaken by gravity, wherever possible. Where, however, dewatering by gravity is not possible, pumping shall be resorted to after this mode has been approved by the Engineer for the particular location, section or stretch.

(ii) Dewatering systems of adequate capacity shall be provided by the contractor for carrying out dewatering of surface as well as the underground construction sites. The contractor shall supply, install, maintain, and operate all dewatering pumps, pipes, supports, channels, troughs, electrical installations, and necessary accessories, and other consumables required to maintain the different work sites free of water during construction.

(iii) The contractor shall provide standby power supply unit commensurate with the capacity of the pumps as to cope with the water inflow into construction sites during periods of breakdown and maintenance of his main power supply units.

(iv) The contractor shall propose the permanent sumps locations for approval of the Engineer. The energy meters for the purpose of measuring energy consumed in dewatering for payment shall be installed at those locations.

(v) The contractor shall ensure that all drainage water will be disposed of without causing interference to his own or other contractors operations elsewhere at the Site and that no drainage water runs into adjacent works. Water discharged from work areas shall not be polluted or endanger the environment. Any polluted water coming from the working sites shall be treated prior to its discharge from the site. Particular attention shall be paid to possible pollution from oil or solvents coming into contact with the water prior to its discharge from the Site. Oil separators shall be provided within the drainage system as necessary.

(vi) If at any time during construction, in the opinion of Engineer, dewatering pumps in addition to the installed dewatering capacities are required in any working area, the contractor shall provide and install such additional capacity of dewatering system as necessary.

(vii) Where, in the opinion of the Engineer, water inflows or potential water inflows into the excavation are to be reduced or controlled by grouting, the Engineer may direct that these inflows be grouted in advance, in accordance with the provisions set out under chapter - Drilling and Grouting.

(viii) Whenever more than one agency are working in the same or adjacent areas, the contractor, who has already provided the drainage facility, shall extend this facility to the other agencies also, who shall pay for such facility at mutually agreed rates. In case of dispute, the apportioning of such expenditure shall be decided by the Engineer, whose decision shall be final. In no case shall any contractor be permitted to stop the drainage system.

(ix) In case there is flow of water passing through the sites of two or more agencies, the drainage shall be attended by the agency in whose site the origin of the water is located to the extent directed by the Engineer. In

tunneling works, this sub-para (14.3 (ix)) shall be applicable only before breakthrough of HRT and after breakthrough, sub-para 14.6.3 (iv) shall be applicable.

(x) The pumped water carried in pipes or flumes shall be discharged at point sufficiently away from the edge of foundation excavation as directed by the Engineer. Care shall be taken to ensure that there is no seepage and flow of water back to the pit working area.

14.4 Dewatering of Surface Construction Sites

14.4.1 General

(i) The contractor shall perform all works necessary to drain the surface construction sites of rain, groundwater and service water. The work shall include, but not be limited to the following:

a) Design and construction of drainage, ditches, pits, and pump sumps and settlement ponds with oil separators.

b) Design, furnishing, operation and maintenance of dewatering equipment.

c) Relocation of dewatering facilities required for the performance of other works.

d) All auxiliary works required for safe and continuous dewatering of the construction Sites.

(ii) Dewatering of surface construction sites located near a river/stream shall be done upto the existing water level in the river/stream by gravity as directed by the Engineer. Suitable drainage shall be made joining the course downstream for the construction site to provide required gradient to facilitate proper and efficient dewatering. Below the water level of the stream, dewatering shall be done by pumping water collected in the sumps and discharging the same into course of the river/stream downstream of the construction site.

(iii) The contractor shall provide the necessary power and energy for operating the pumps and well point, if any, system. The standby power supply shall undergo weekly trial runs lasting at least 30 minutes.

(iv) The contractor shall take measures to ensure that the foundation surfaces remain free of standing water and undamaged by the passage of construction traffic. All ditches shall be outside the foundation areas.

14.4.2 Requirements and Design

(i) The contractor shall design and install complete facilities at the surface construction sites.

(ii) The surface water dewatering system shall be designed to accommodate, without undue disruption to the work, any rainfall event and taking into

account the extent of the sites to be dewatered and the dewatering arrangements proposed.

(iii) The contractor shall provide adequate pumping capacity for electric Pumps, including sufficient number of standby pumping units, to handle all water entering into any of surface construction sites. In addition, he shall provide sumps and pumps and/or well points in the immediate vicinity of the structure foundations using such water conductors as are necessary to conduct the water away from the excavation and concrete placement operations in an approved manner, so that such operation shall be kept free from standing or running water.

(iv) Power for operating the dewatering system shall be arranged by the contractor himself. Engineer in no way shall be responsible for failure or interruption in the power supply from the source arranged by the contractor. The contractor shall therefore make his own arrangement for sufficient standby power to carry on the works during any interruption of power.

(v) The contractor shall ensure that all drainage water is disposed off without causing interference to his own or other contractors' operations elsewhere on the site and that no drainage water runs into adjacent works.

(vi) The dewatering systems shall be designed and installed in such a way that modifications and extensions to the systems are possible while they are in full operation.

(vii) All the components of the dewatering system shall be installed and operated in accordance with the approved method and the construction time schedule, or approved modification thereof.

(viii) The approval by the Engineer of the dewatering system shall not relieve the contractor from being fully responsible for the design, construction, operation, maintenance, safety and removal of the facilities provided for the dewatering system and he shall be liable for any damage or delays caused by its failure. The contractor shall indemnify the Employer against claims arising out of any such failure made by a third party.

14.4.3 Materials and Execution

(i) Drainage ditches shall be excavated along the top of excavated slopes and on the berms. Such ditches shall be kept well back from the excavation edges in order to prevent saturating the upper part of the slopes. The ditches shall be regularly cleaned out of all accumulated silt and other matter so that water may flow freely at all times.

(ii) Where excavation is to be made below the groundwater table, the contractor shall lower the water table sufficiently below any working surface by means of properly screened wells and/or ditches to ensure that the foundation surfaces remain free of standing water and undamaged by the passage of construction traffic. All ditches shall be outside the foundation areas. The water shall be collected and removed by pumping, if no outflow by gravity is possible.

(iii) Where concrete is to be placed, the water table shall be maintained below the lowest part of the finished excavation for minimum one day following the raising of structure above the natural groundwater table, and for such additional time as may be necessary to preclude damages to structure foundation.

(iv) In trenches and foundations, the dewatering shall at all times enable to carry out the excavation work in dry, and in a manner that will prevent loss of fines from the foundation.

(v) Upon completion of dewatering, temporary pipes and pump sumps beneath permanent structures shall be closed off and completely filled with grout, mortar or concrete as required by the Engineer.

14.5 Dewatering of Underground Construction Sites

14.5.1 General

(i) The contractor shall perform all works necessary to collect and drain service and infiltrating groundwater, convey it to main conduits, and lead it out from underground works such as tunnels, caverns and adits.

(ii) The Work shall include, but not be limited to, the following:

(a) Design and construction of pits and trenches.

(b) Design, furnishing, operation, and maintenance of dewatering equipment.

(c) Relocation of dewatering facilities required for the performance of other Underground Works.

(d) All auxiliary works required for the safe and continuous dewatering of the underground Sites.

(e) Design, construction and operation of settlement ponds with oil separators at the portals,

(iii) Probe holes, as specified in Chapter - Underground Excavation shall be drilled to provide information on the inflow of water into the tunnel as the excavation proceeds. Where the indications are that flows are likely to be large, grouting to seal off the water flows and drilling of drainage holes may be required and the same shall be undertaken with the approval of Engineer.

14.5.2 Requirements and Design

(i) The contractor shall design and provide a complete dewatering system for both the downstream and the upstream headings. Dewatering of the upstream heading shall be carried out by gravity alone.

(ii) All excavated areas shall be drained off completely in order to keep the construction areas free from water. The dewatering systems shall be able to operate at any time during the whole construction period in any part of the works at the required designed capacity.

(iii) The contractor shall provide adequate pumping capacity for electric pumps, including a sufficient number of standby pumping units, to handle all water entering into any portion of underground works. These units shall be connected to the dewatering systems in such a way that proper and uninterrupted drainage is guaranteed throughout the entire construction period.

(iv) Power for operating the dewatering system shall be arranged by the contractor himself. The Employer in no way shall be responsible for failure or interruption in the power supply from the source arranged by the contractor. The contractor shall therefore make his own arrangement for sufficient standby power to carry on the works during any interruption of power.

(v) All components of the system shall always be maintained in ready-for-service condition and all access to pumps and other equipment shall be kept in good condition under the most adverse conditions.

(vi) The contractor shall ensure that all drainage water is disposed off without causing interference to his own or other contractors' operations elsewhere on the site, and that no drainage water runs into adjacent works.

(vii) The dewatering system shall be designed and installed in such a way that modifications and extensions to the system are possible while they are in full operation.

(viii) All the components of the dewatering system shall be installed and operated in accordance with the approved method and the construction time schedule, or approved modifications thereof.

(ix) The approval by the Engineer of the dewatering system shall not relieve the contractor from being fully responsible for the design, construction, operation, maintenance, safety and removal of the facilities provided for the dewatering system and he shall be liable for any damage or delays caused by its failure. The contractor shall indemnify the Employer against claims arising out of any such failure made by a third party.

14.5.3 Materials and Execution

(i) The contractor shall construct the drainage trench in the access adits and inverts of the tunnel and other underground works as shown on the drawings.

(ii) After the excavated profile has been checked, the ground water which runs or drips into the excavated space shall be diverted into the drainage trench by means of water collectors and pipes for collecting the seepage water from rock surfaces or steel laggings. Damp surfaces or seepage areas with low volume inflows can be sealed off with a quick-setting sealing compound.

(iii) Special care shall be exercised where excavation passes through material which is liable to soften or swell when it comes in contact with water. In such locations, the water entering the excavated space shall be collected as soon as possible and conveyed away in a pipe or other impervious channel in such a way that the water does not come in contact with such material.

Should the contractor neglect to observe this requirement and a deterioration of the tunnel invert results from water being allowed to flow over or stand upon the sensitive or swelling material, the Engineer may order the removal of the affected material and its replacement with concrete. The Engineer may order installation of additional rock supports in connection with such remedial work.

(iv) If any water from another portion of the tunnel or cavern flows into a lower section where concreting is being done, which is likely to be affected by water, all such water shall be diverted past this area in such a way that no damage occurs to the concrete. The length of the affected sections over which water has to be diverted shall be ordered by the Engineer.

(v) The contractor shall perform regular checking and cleaning of the drainage trench and all dewatering equipment and accessories during the construction period.

(vi) The dewatering facilities shall be kept in operation according to the approved schedule, which shall be related to the progress of the work. No pumps shall be stopped, no pipes, ducts, trenches, etc., shall be taken out of service without the permission of the Engineer.

(vii) Any openings such as pipes, boreholes, ducts, pump sumps etc., used for temporary drainage purposes in any part of the works shall be completely sealed by filling with grout, mortar or concrete when no longer required, unless otherwise directed by the Engineer in writing. The contractor shall notify the Engineer in writing before any such openings are permanently closed.

14.6 Measurement and Payments

14.6.1 General

(i) The contractor shall ensure that dewatering pumps supplied by him perform in accordance with the manufacturer's specifications. In the event of any of dewatering pumps provided by contractor consume energy in excess of the values specified by manufacturer, the same shall be repaired and replaced by contractor at his own cost, without delay and to the entire satisfaction of Engineer.

(ii) Each pump installed shall undergo a weekly trial testing to demonstrate that it is actually discharging the water at its rated capacity and head. If significant deviations (more than 10% below) are discovered the Unit Price for pumping through that pump will be proportionally reduced for the period of the past 7 days, or until the time of the last pump testing, whichever may apply. Where several pumps are installed at the same site, the weighted average of the capacity of all installed pumps shall be calculated and the Unit Price proportionally reduced. The pump capacity will be measured at the outlet of the installed pipeline.

(iii) The meters and other electrical connections shall be installed by the contractor at his own expense. Meters shall be calibrated and tested

before installation and the test reports shall be submitted to the Engineer prior to installation.

(iv) The contractor shall not be entitled to any claim or compensation due to failure or interruptions in electric supply.

14.6.2 Dewatering of Surface Construction Sites

(i) Measurement for payment and payment for dewatering the surface construction sites will be made in the following manner:

a) Measurement for payment and payment for providing/installation of equipment for electric pumps and pumping of water from the surface construction sites will be made at the Unit Rate per kilowatt hour of energy consumed which shall include, but not be limited to, the following:

- Design of all dewatering system.
- Excavation, construction and protection of drainage ditches, wells, pits and pump sumps.
- Capturing and conveying the water into the drainage system.
- Providing/transportation and installation, removal of pumps, regardless of the amount of water.
- All costs of supply, installation, maintenance and removal of pipelines and all other accessories.
- Grouting of pipes and pump sumps, if required.
- Cost of power supply.
- All auxiliary works required.

14.6.3 Dewatering of Underground Construction Sites

(i) Measurement for payment and payment for dewatering the underground construction sites including dewatering under geothermal conditions irrespective of temperature of water shall be made in the following manner.

(a) Measurement for payment and payment for providing/installation of equipment for electric pumps and pumping of water from the underground construction sites will be made at the Unit Rate per kilowatt hour of energy which shall include, but not be limited to, the following :

- Design of all dewatering system.
- Excavation of drainage trenches and sumps etc.

- Providing/ transportation and installation of dewatering equipment to the site of works.
- Installation and removal of pipe lines and all other accessories.
- Moving of the pumps and pipes as necessary between different locations.
- Operation and maintenance of the dewatering system regardless of amount of water and disposal of all water upto the disposal points specified by the Engineer.
- Cost of power
- All auxiliary works required.
- Grouting of pipes and pump sumps, if required.

(ii) No extra measurement for payment or payment will be made for dealing with water and dewatering of underground construction sites by gravity, and the entire cost thereof shall be included in the Unit Prices for other items of the works. However, in case of exceptional circumstances (abnormal ingress of water), dewatering using pumps as directed by the Engineer will be payable at the rates enterd in Bill of Quantities in Kilowatt Hour of energy.

(iii) Payment for grouting and other treatment of seepage and fill grouting of drainage system will be made as stipulated in Section "Drilling and Grouting".

(iv) Dewatering of u/s water by gravity after breakthrough of the HRT will be done by d/s contractor without any cost liability to Employer. For additional dewatering volume on this account, appropriate arrangement will be made by the d/s contractor. However, if the dewatering is required to be done by pumping as approved by Engineer, payment will be made at the unit rate entered in the Bill of Quantity.

14.6.4 No Measurement for Payment or Payment Will be Made for the Following and the cost thereof shall be deemed to be included in the Unit Rates of other items of the works:

(a) Diverting and discharging water during any concreting operations except for pumping in the downstream headings in case such concreting is carried out prior to the break-through. Diverting and pumping water on upstream face during concreting operation.

(b) Any work or materials required as a result of contractor's non-observance of the requirements concerning sensitive or swelling ground when the excavated surfaces have been allowed to become unsuitable due to the action of ground or service water.

(c) Any dewatering done by pumping by the contractor in contravention of the instructions of the Engineer.

(d) Excavation of drains and sumps required for dewatering purpose,

(e) Piping arrangement, consumables, maintenance and repairs/replacement of dewatering system,

(f) Caulking or plugging,

(g) Construction, operation and maintenance of the settlement ponds, or other devices for treatment of polluted water.

CHAPTER – 15

ROCK MECHANICS TESTS AND INSTRUMENTATION

INDEX

15.1 Scope of work

(i) The rock mechanics tests and instrumentation at various locations of the underground and other works will be carried out by the Engineer.

(ii) The work to be done by the contractor so as to enable the Engineer to conduct the rock mechanics tests shall comprise supply of all constructional plant, labour and materials required for carrying out additional excavation, drilling, preparation of rock surfaces, construction of concrete and mortar pads and backfilling with concrete as and where directed by the Engineer.

(iii) The work to be done by the contractor for enabling the Engineer to undertake the instrumentation shall comprise supply of all constructional plant, labour and materials required for drilling holes, preparing rock surfaces, providing necessary assistance for installation at the intended locations and protection of instruments as well as in taking readings and removal of instruments as and when required by the Engineer.

(iv) Excavation, drilling, washing, pressure testing and backfilling with concrete, if considered necessary, for carrying out rock mechanics tests shall be carried out in accordance with the provisions made for these items of works in the contract.

(v) The Engineer will supply all the test equipment and instruments required for carrying out the rock mechanics tests and instrumentation. The Engineer will install, with the contractor's assistance, the instruments specified herein. Any accessories that may be required for this purpose will also be arranged by the Engineer.

(vi) The extent of work covered under these specifications shall depend on the actual conditions encountered and the Engineer may modify the number and location of sections for instrumentation and rock mechanics tests and adjust the number of holes drilled and instruments installed at each instrument location.

15.2 Rock Mechanics Tests

15.2.1 General

The rock mechanics tests, to be carried out by the Engineer, will include, but not be limited to, the following:

(a) Seismic refraction measurement

(b) Plate bearing tests.

(c) Dilatometer tests.

(d) Hydro fracturing tests.

(e) Block shear tests.

(f) Over coring tests

(g) Flat Jack tests

(h) UCS Tests.

(i) Permeability tests

(j) Blast vibration studies

(i) The contractor shall coordinate with the Engineer to enable the rock mechanics tests to proceed while underground excavation continues. Seismic refraction tests will be performed when no construction activity is taking place underground.

(ii) The contractor shall make available at all times, labour and equipment necessary to perform the work described herein or as determined by the Engineer. He shall make provisions in his planned excavation activities to enable such work to be carried out concurrently with the main excavation without disruption or delay.

15.2.2 Execution

The work to be carried out by the contractor for the above-mentioned tests shall include, but not be limited, to that described below:

(i) The contractor shall excavate test chambers, wherever required, in the underground excavation as directed by the Engineer.

(ii) The rock face to be tested shall be prepared by removing rock damaged by blasting. The test area shall be made as flat and smooth as possible by the use of hand tools. A thin mortar pad shall then be laid on the rock to provide a flat and even surface.

(iii) The contractor shall drill holes of diameter, length and in the direction as specified by the Engineer, for the performance of rock mechanics tests.

(iv) The contractor shall carry out drilling with continuous core recovery wherever required by the Engineer. Cores shall be stored in core boxes for logging and testing purposes.

(v) If the rock conditions so dictate, the Engineer may require the drilling operations to be interrupted to allow the performance of the required tests.

(vi) The contractor shall ensure that all the works required for installation of instruments are done before proceeding too far away/ahead of location of the instruments.

(vii) The contractor shall supply and provide all materials such as cement, sand, aggregate, grouting, etc. required for the installation of the instruments.

(viii) Suitable protective coverage shall be installed on all the instruments as per the instructions of Engineer.

15.3 Instrumentation

(i) The following instruments will be supplied, installed and monitored by the Engineer in order to assess the behaviour of the rock and various other structures during and after construction.

(a) "Single-Point Borehole Extensometers".

These will be used to measure the deformation of rock and will be similar in construction and installation to rock bolts. Holes for installation shall be drilled close to the blast face as required by the Engineer. Installation may be made from the drill platforms during the drilling cycle. The length of these instruments shall be variable and shall generally not exceed 20 meters.

(b) "Multiple-Point Borehole Extensometers".

These will be used for the purpose of measuring deformation/movement in rock at different depths. Holes required for installation will be 76 mm dia or more and shall be drilled by the contractor. Such instruments shall be installed to a depth which shall generally not exceed 30 meters.

(c) "Convergence Measurement"

These instruments will be used to measure deformations of the rock around the surface of the excavation. A location shall consist of a series of node points (studs) for cross-measurement and installed as close as possible to the blast face. This will involve small length of drilling at each point.

(d) "Piezometers"

These will be used to measure pore pressures and will be installed to depths specified by the Engineer, generally not exceeding 40 meters.

(e) "Laser Reflector Prisms"

These will be installed on mounts welded to stainless steel to the reference points as directed by the Engineer.

(f) "Load Cells"

These will be installed on selected prestressed rock bolts or rock anchors.

(g) "Stress-Meters"

These will be used for the purpose of determining stress changes in the rock or support systems as excavation proceeds. Stress meters include flat jacks, strain rosettes, and strain gauges.

(h) "Inclinometer"

These will be used for the purpose of measuring the stability of slopes.

Other instruments not specified herein may also be installed. The work required to be done by the contractor shall be of the same general nature as for installation of instruments specified herein above.

(ii) In general, instruments shall be installed so as not to hinder normal operations of the contractor. However, on exceptional occasions the Engineer intends to install instruments as near as possible to the blast face and as soon as possible after blasting. In such instances the Engineer will inform the contractor, in writing prior to such installations.

(iii) The contractor shall prepare specified areas for instrumentation by barring, chipping with pneumatic hammer, cleaning with air-water jet or other preparatory means as required by the Engineer until the required result is obtained. In some cases, final finish shall be completed by applying neat comment paste, grout or other material as directed by the Engineer.

(iv) The contractor shall drill holes in rock and where required in concrete and rock for the installation of instruments as required by the Engineer. All drilling methods used shall be approved by the Engineer. Generally, percussion drilling shall be acceptable for single holes upto 9 meters long, but the Engineer may request that diamond drills be used and that “BX”, NX and “AX” size cores be taken. All drill holes shall be flushed with clean water and shall be entirely free of debris. Holes which the Engineer considers unsatisfactory because of location, alignment or other irregularities shall be redrilled as directed, in the immediate vicinity. The hole diameter and the depth shall be as specified on the drawings or as directed by the Engineer.

(v) To recess instruments into the rock face it may be necessary to remove rock cores upto 300mm diameter.

(vi) The contractor shall provide temporary access, such as stationary or transportable working platform and lighting, as required by the Engineer, necessary for installing the instruments. The Engineer shall install all instruments and perform specialized work, such as setting, measuring and adjusting of instrument during installation. The contractor shall cooperate with the Engineer in this work and shall take all precautions to protect these instruments and devices alongwith their cables during and after their installation. Any instruments or devices which are damaged by careless or negligent operation by the contractor may be replaced at the option of the Engineer at the contractor’s cost. The contractor shall supply and install blast protection devices as required by the Engineer.

(vii) In order that the instruments installed may be read during excavation, the contractor shall provide temporary walk-ways, cranes or mobile platform as required by the Engineer until such time as the access is possible from completed permanent structures. In addition, access to other instruments by means of portable ladders or other facilities that shall permit standing with arms free while

checking the instrument shall be required by the Engineer. These temporary walk-ways and other means of access shall be maintained by the contractor in a safe condition at all times.

15.4 Measurement and Payments

(i) All excavations required in connection with carrying out rock mechanics tests and instrumentation will be measured and paid for as additional excavation as specified in chapter - Underground Excavation.

(ii) The backfilling of additional excavations, with concrete after completion of tests and instrumentation will be measured and paid for at the same applicable Unit Rates entered in the Bill of Quantities as for backfilling of voids created by approved geological over break.

(iii) Drilling of holes and grouting required for carrying out rock mechanics tests and instrumentation will be measured and paid for at the unit rates as specified in Chapter - Drilling and Grouting.

(iv) All other works or services required in connection with performance of rock mechanics tests and instrumentation will be paid at the Rates to be analyzed and approved by the Engineer.

(v) The contractor shall not be entitled to any extension of time for the completion of works or any additional payments, other than as described above, as a result of such work, or the performance of the above mentioned tests by the Engineer.

(vi) The contractor at his own cost shall be liable for repairs and replacement of instruments and devices, which are damaged due to careless or negligent operations of the contractor.

CHAPTER - 16

ENVIRONMENT PROTECTION MEASURES

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16.1 General

(i) The contractor's activities towards environment protection measures shall include construction of gabions/wire crates filled with stones, retaining walls (with RR masonry or concrete), rip rap protection, turfing, dust suppression with waters sprinkling etc., in order to prevent entrance or accidental spillage of solid matter containment, debris and other objectionable pollutions and wastage into the river, drainage channels, road other private/government properties etc. Construction drawings for the different items under this sub head shall be prepared by the contractor and got approved from Engineer before execution. In addition to the above measures, the contractor shall also provide for appropriate additional measures if required to satisfy the provisions of Environment Rules and Regulation of GoN, conditions imposed on the project in the clearance and other relevant regulations. However, in case, additional measures, if any are imposed by Govt. of Nepal during execution of Contract, payment for the same shall be made at the rates in Bill of Quantities and if not available in Bill of Quantities, at the rate determined as per contract provisions. Pollutants and wastes shall be disposed off in a manner and at sites approved by the Engineer. In addition to compliance with provisions of various notifications of GoN, the contractor has to obtain/comply all permissions, clearances as per Environment Rules and Regulation, GoN notifications during the entire period of his construction activities at his own cost.

(ii) The cost for implementing measures, if any, required to protect the environment in accordance with provisions of contract shall be included in the rates quoted for the various items and no separate payment will be admissible for items other than the items specifically mentioned in BOQ. Measures, if any required in accordance with provisions of contract will be complied with by the contractor, within reasonable time after issue of the notice. If the above is not complied with, the necessary work shall be carried out by the Engineer at the risk and cost of the contractor.

Contractor shall make necessary arrangement to prevent pollution of the water in any stream, spring, nallah and river. The contractor shall be solely responsible and liable for all damages caused by any pollution that may take place during the execution of works. In the event of any failure or inadequacy on account of the activities of the contractor resulting in to issue of notices/compensation demand by Employer/Statutory Authority of Govt. of Nepal, the contractor shall be liable for all such defaults. The contractor shall rectify/compensate the demands of all such notices to the full satisfaction of the concerned Authorities, without any financial liability to Employer.

16.1.1 Environmental Obligations

(i) The contractor shall, during the whole period of the works comply fully with all Nepalese laws and regulations relating to environmental protection, mitigating measures for reducing environmental impacts and remedial works on completion of the Works. This obligation shall extend to the construction sites themselves, all the contractor's site installations, and all quarries, borrow areas and spoil tips.

(ii) Notwithstanding any specific obligations as these may be specified in prevailing Indian laws and regulations, the contractor shall at all times comply with the following particular requirements for the protection of the environment, the local population and the workers at the construction site:

(a) Collect, treat, remove from site and dispose of in accordance with the regulations and to the satisfaction of the Engineer all domestic and industrial waste and excess construction materials (both solid and liquid), fuel, chemicals and other matter.

(b) Make every effort to minimise the harmful effects of transport to and from the site, in particular vehicle emissions and noise and the control of dust on roads.

(c) Provide its work force with fuel for cooking and heating and ensure that workers on the site do not cut wood or other vegetation as firewood.

(d) Take measures and construct works, on the instructions of the Engineer, to prevent soil erosion from slopes in the construction area.

(e) Not clear any areas of forest or woodland without the authority of the Engineer and statutory authorities.

(iii) In order to reduce adverse effect on public health resulting from the influx into the project area on construction workers, the contractor will be obliged to undertake during the whole construction period the following preventive measures:

(a) Ensure that all construction staff and workers, prior to being accepted to work on site, submit certificates of good health and, during the construction period, ensure that all employees are given a periodic physical examination (at least once a year and following any serious illness) by a qualified registered medical practitioner.

(b) Ensure that workers suffering from noticeable contagious illnesses are removed from the site for treatment and are not permitted to return to the site without an updated medical certificate.

(c) Carry out regular spraying of all parts of the site and site installations to control mosquito vector diseases, using approved insecticides.

(d) Implement a control programme to ensure the maintenance of satisfactory sanitary conditions on the site and in the living areas, and report to the Engineer all cases of serious enteric and/or water-borne illness.

(iv) The contractor will send representatives to constituted project environmental monitoring committees, as instructed with the Engineer, and will at all times comply with the requests of said committees with regard to the need for environmental or health protection measures. He will also maintain close contact with local representatives and government institutions in addressing issues arising from the construction activities. Such issues requiring particular attention are the following:

(a) Pollution caused by construction work.

(b) Disputes related to the leasing of land for construction activities and/or site installations etc.

(c) Disputes arising from traffic congestion and restrictions on the use of the main project access road and roads in the project area.

(d) All matters relating to road safety and the reduction to a minimum of the risk of traffic accidents.

(v) The contractor will submit to the Engineer monthly reports on environmental performance and control. These reports will give details of all environmental protection measures taken during the months, as well as:

(a) Any environmental problems encountered during the month.

(b) Details of health conditions, in particular any occurrence of contagious illness and any accidents.

(c) Any notices received from GoN institutions relating to environmental matters, and the action taken by the contractor as a result.

(vi) The contractor will co-operate with the local authorities at all times to prevent migration to the area, of unauthorised persons not involved directly in the construction work. To this end, he will at all times strictly control the movement of persons into and out of the construction areas and camps.

16.1.2 Measurement and Payment

No separate payment shall be made for complying with any environmental obligations required by Nepalese laws and regulations, and/or as described in this Chapter, and all such costs incurred by the contractor to this end shall be considered as being included in the contractor's Unit Prices.

16.2 Gabions

16.2.1 Scope of work

The scope of work under this item covers supplying and installing rock or boulder filled Gabions in place as per approved drawings or as directed by Engineer.

16.2.2 Standards

i) The work shall be carried out as per following Indian standards or, where not covered by these standards, to their equivalent international standards (latest edition)

IS:280	Mild steel wire for general Engineering purposes
IS:4826	Hot dipped Galvanized coating on round steel wire
IS:12753	Electro Galvaized coating on round steel wire
IS: 16014	Mechanically woven, double-twisted, hexagonal wire mesh gabions, revet mattresses and rock fall netting (Galvanized steel wire or Galvanized steel wire with pvc coating) — specification
IS:13360(Part-5)	Plastics: Method of testing
IS:4454	Steel wire for Mechanical Spring- Specification

ii) In case of conflict between the above standards and the specifications given herein, the specifications shall take precedence.

16.2.3 Material

16.2.3.1 Rock

Rocks to be placed in the gabions shall be clean, hard, dense, sound and of a quality that shall resist the action of water weathering. Rocks to be placed in gabions shall have the following characteristics:

- Water absorption < 5%
- Los Angeles abrasion value <40%
- Sodium Sulphate < 12%
- Slake Durability Index >90%

Rocks to be placed in gabions shall be uniform in shape, in all three dimensions. The smallest dimension of the rocks shall be at least 1.5 times (preferably) the size of the mesh. The maximum dimension of the rocks shall be 0.5 times the thickness of the gabion.

Stones for hand pitching in the front 150mm thick face shall be carefully selected and placed in position to achieve a well bonded, neat, visually attractive, flat surface, and free from bulges and/or depressions.

16.2.3.2 Gabions

A wire mesh container of variable sizes ,uniformly partitioned into internal cells, interconnected with other similar units, and filled with stone at project site to form flexible, permeable monolithic structure for earth retaining and erosion control purpose, such as retaining walls, weirs etc.

16.2.3.3 Double twisted wire mesh

A non ravelling mesh made by continuous pairs of wires through three one half turns (commonly called double twisted) to form hexagonal shaped openings which are then interconnected to adjacent wires to form hexagonal openings.

16.2.3.4 Selvedge wire

A terminal wire used to edge wire mesh perpendicular to double twist by mechanically wrapping the mesh wires around it at least 2.5 times.

16.2.3.5 Edge wire

A terminal wire of the same diameter as the selvedge wire used to edge the wire mesh parallel to double twist by continuously weaving it mechanically into wire mesh.

16.2.3.6 Lacing wire

A galvanized wire coating used to assemble and interconnect empty units , to close and secure stone filled units, and for internal stiffeners.

16.2.3.7 Diaphragm

An internal partition made up of same wire mesh panel in Gabion that is attached to bottom ,the sides, after the gabion cage is packed with stone, to the lid of cage.

16.2.3.8 Classification

Double twisted wire mesh gabions are classified according to coating as follows:

(i) Class- I

It consists of double twisted wire mesh made from wire which is zinc-coated, before being double twisted into mesh. Fasteners, lacing wire and stiffeners are produced from zinc coated wire.

(ii) Class-II

It consists of double twisted mesh shall be manufactured from the same type of galvanized steel wire as Class-I with an additional PVC coating extruded onto the galvanized steel wire.

16.2.3.9 Material and Manufacture

i) The wire used in manufacture of double twisted mesh for use in Gabions shall conform to IS 280.
ii) The double twisted mesh size(class-I) shall be manufactured from zinc-coated steel wire conforming to IS 4826, heavily coated and soft type or IS 12753(heavy coated)
iii) Lacing wire and stiffeners shall be made up of wire having the same coating material as the double twisted wire mesh furnished on the order and conforming to IS 4826 or IS 12753(heavy coated) .

iv) Galvanized Rings: Fasteners made from galvanized steel wire of 3mm diameter shall be used for products of Class- 1 type mesh.

16.2.3.10 Mesh and Box Characteristics

The nominal mesh opening size, diameter of the galvanized steel wire and the standard dimensions for gabions shall conform to the values as per table given below:

Mesh Type	'D'Nominal Size,mm	Tolerances
8 x10	80	+16% to -4%

Mesh Type (mm)	80 x 100
'D',mm	80
Wire Type	Zinc Coated
Mesh Wire dia,mm	3.0
Edge Selvedge Wire dia.,mm	3.90
Lacing Wire dia.	2.2
Tolerances in size of Gabion Boxes	Length and Width ...±5%, Height>0.3m... ±5%, and Height ≤0.3m..... ...±10%

16.2.3.11 Mechanical Properties

(i) Tensile Strength: The tensile strength of wire used for double twisted mesh, lacing wire and stiffener when tested shall be in accordance with the requirements of IS 280 for soft wire 450 MPa(±10%) at a minimum elongation of 10%,performed on a gauge length of test specimen as 200mm.

(ii) Mesh Panel Strength: The minimum strength requirements of the mesh, when tested is as shown under:

Sr. No	Mesh Type	Mesh wire dia.(mm)	Min tensile strength Parallel to	Min tensile strength Perpendicular to

			twist ,KN/m	twist ,KN/m
1	Zinc Coated	3.00	51	26.5

16.2.3.12 Dimensions and Tolerances

The diameter of galvanized steel wire shall conform to the values as given below:

Sr No	Nominal Dia. of Galvanized wire (mm)	Mass of Zinc coating (g/m2)	Permitted tolerance on wire diameters(mm)
1	2.20	240	± 0.06
2	3.00	270	± 0.08
3	3.90	280	± 0.10

all other specification and testing shall confirm to IS: 16014

16.2.3.13 Measurements and Payment

The rate quoted shall be applicable per m^3 of rock fill placed inside the Gabions, including the cost of Gabions. The dimensions to compute volume shall be measured as the dimensions of final Gabions in place. The payment shall be made as per the rates quoted by the contractor in the BOQ.

16.3 Random Rubble Masonry

16.3.1 Scope of Work

The scope of work under this item covers supplying and construction of RRM in cement mortar as per approved drawings or as directed by Engineer.

16.3.2 Material

16.3.2.1 Stones

Stones used shall conform to the specifications laid down in IS: 1597 (part- 1) obtained from quarries approved by Engineer. The stone shall be of hard, tough, sound and durable quality free from voids, flaws, cracks, earth cover, zeolite etc.

The stone shall be free from defects like cavities, cracks, flaws, sand holes veins, patches of soft or loose materials, etc. Generally, the stone should not contain cryptocrystalline silica or chert, mica or any other deleterious material like iron oxide, organic impurities, etc.

The stone shall be such as not to absorb more than a quarter percent of water by weight after being kept under water for twenty four hours.

Other material such as cement, sand and water shall conform to the relevant specifications for concrete, provided elsewhere in the tender documents.

16.3.2.2 Mortar

The mortar shall consist of one part of cement and six parts of sand. Dry mortar shall be prepared by using sand corresponding to one bag of cement measured by batching boxes, and then spreading one bag of cement over it. The mixture shall then be thoroughly mixed and then specified quantity of water added to obtain the final mortar for use. Mortar, once mixed, shall be consumed preferably within 30 minutes in any case. Old mortar remaining back in taslas shall be thrown away and taslas thoroughly cleaned before filling the same with fresh mortar. In no case fresh mortar shall be mixed with old mortar.

16.3.2.3 Plastic Pipes

These pipes shall be low density polyethylene pipe for drainage purpose as per IS-3076(latest edition). The diameter used shall be 75mm for proper drainage in retaining wall.

16.3.3. Dressing

Stones as received from the quarry shall have their weak corners and edges knocked off and hammer dressed on the face, the sides and the beds to enable them to come into proximity with neighbouring stones.

16.3.4 Laying

The stones shall be wetted before laying. Every stone shall be carefully fitted to the adjacent stones so as to form close joints as far as possible,. The clips and spalls of stone shall be used wherever necessary to avoid thick mortar beds and joints. The clips shall not be used below the hearting stones and their use shall be restricted to the filling of inter stick between the adjacent stones in the hearting and these shall not exceed 20% of the quantity of stone masonry.

The masonry shall be carried up regularly and no step shall be allowed more than 60 cm. When the masonry of one part has to be delayed, the work shall be raked back at an angle not exceeding 45°.

Bond stones running through the thickness of wall shall be provided in walls upto 60 cm thick. If these walls are more than 60 cm thick, two or more bond stones, overlapping each other by at least 2 cm, shall be provided on a line from face to back. At least one bond stone or a set of bond stones shall be provided for every 0.5m^2 of wall surface. The walls shall be carried out truly in plumb. The thickness of the joint shall not exceed 2.5cm.

16.3.5 Protection and curing

The masonry during construction shall be protected from sun rain by suitable covering and the masonry shall be kept moist for at least ten days after completion. When the work is to be done under frost condition, special precautions shall be taken as directed by Engineer such as mixing of calcium chloride at the rate of 1.5% in cement, use of warm water in mixing and curing, covering of masonry with gunny bags, etc. Watering shall be carefully done so as not to wash any mortar out of the joints. The curing shall be done for 21 days.

16.3.6 Plum Concrete

The wall shall be filled with plum cement concrete 1:3:6 with 75% graded material of minimum size of 40mm and 25% plums of 150mm size.

16.3.7 Measurement and Payments

The in place volume of Random Rubble Masonry (RRM) and plum concrete shall be computed from the approved drawings. The price quoted per m^3 shall include the cost of rock material, cement mortar, labour, all

leads and lifts and compensation towards all other materials, constrains and works required to carryout the work as per approved drawings, specifications as directed by Engineer. The payment shall be made as per the rates quoted by the contractor in the Bill of Quantity.

16.4 Turfing

16.4.1 Scope of Work

- The scope of work under this item covers the following: covering the top soil
- The preparation of surfaces to be covered.
- The collection of stored earth and its transport.
- Spreading, flattening and rolling out.
- The shaping and levelling of the surface.

16.4.2 Turfing

- The preparation of surfaces to be covered.
- Mixing of grass sees with topsoil.
- Laying and geo green erosion control Blanket.
- The operations necessary for its installation.
- Spreading and rolling out.
- The supply and planting of the seeds and tree species.
- Cost of reseeding in case of failure, as many times as necessary.
- The first mowing.

ii) After the closure of dumping area, immediate restoration activities need to be started using Geo-green erosion control blanket as detailed under:

16.4.3 Specification

Fibre: Coir ; fibre content : 100% Coir; Weight: 600g /sqm : Functional longevity: 36 months ; Bottom netting size : 14X14 mm ; Top netting size: 14X14 mm ; Bottom netting Weight : 4.8 g/sg m ; Top netting weight: 4.8 g/sg m; Stitching thread: HDPE Monofilament(Brown, UV Stabilized;

Stitching Thread tensile strength : 50 Cn/ tex; Slope recommendation; >1:1

16.4.4 Execution Procedure

(1) Surface Preparation: The dumped muck will be excavated up to a depth of 30 cm and all undulation levelled.

(ii) supplying and mixing of good earth : Good earth will be imported and mixed with existing earth up to a depth of 20 cm (40% existing earth and 60% good earth)

(iii) Mixing manure with earth along the soil conditioner: Good earth will be mixed with manure and soil conditioner up to a depth of 10 cm above the previous layer of existing earth and good earth (30% manure, 70% good earth and 1 kg per sqm soil conditioner).

(iv) Mixing seeds with top layer : the native grass seeds will be mixed with top layer uniformly with the ratio of 250Kg/ha.

(v) Laying of Geo-green erosion control blanket: the geo green control blanket will be laid above the top layer and anchored suitably at the top as per specifications of manufacture. Overlapping blankets will also be anchored.

(vi) Plantation of plants/live cuttings: Species of plants/live cuttings which will be planted are as under with the ration of 1000 No./ha:

- Elder tree (Utish) or any other Native Plants / ornamental suitable in Nepal climate.

(vii) Watering: the watering has to be done for a period of 6 months from the date of planting of species.

16.4.5 Measurement and Payment.

Measurement for payment and payment of turfing works shall be made as per the unit rate entered in BOQ.

CHAPTER - 17

STEEL LINER

DELETED

CHAPTER -18

BRICK WORK

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18.1 Scope of work

The specification described herein-under cover all labour, material, equipments and services required for the supply, handling, storing and placing in position brick work in cement mortar as per approved drawing or as per direction of Engineer.

18.2 Standards

The procurement, placement construction of common burnt clay building bricks shall confirm to following latest edition of Indian Standards or where not covered by these standards, to their equivalent International Standards.

IS:1077 - Common burnt clay building bricks-Specification

IS:1200 (Part-3) - Method of measurement of building and civil engineering works: Part-III Brick work

IS:2212 - Code of practice for brick work

IS:5454 - Method of sampling of clay building bricks

IS 3495:(Pt 1 to 4) - Methods of Tests of Burnt Clay Building Bricks

Part 1 - Determination of Compressive Strength

Part 2 - Determination of Water Absorption

Part 3 - Determination of Efflorescence

Part 4 - Determination of Warpage

18.3 Bricks

Common burnt clay bricks shall be hand moulded or machine moulded. They shall be free from nodules of free lime, visible cracks, flaws page war and organic matter, have a frog 100mm in length, 40mm in width and 10mm to 20mm deep on one of its flat sides. Each brick shall be marked in the frog, where provided, with the manufacturer's identification mark or initials.

18.3.1 Dimensions

The bricks may be modular or non-modular. Sizes for both types of bricks shall be as follow while use of modular bricks is recommended non-modular (FPS) bricks can also be used where so specified. Non-modular bricks of sizes other than the sizes mentioned below may also be used where specified by Engineer.

Type of Bricks	Nominal size (mm)	Actual size (mm)
Modular Bricks	200x 100 x 100 mm	190 x 90 x 90 mm
Non-modular bricks	229 x 114 x 70 mm	225 x 111 x 70 mm

18.3.2 Classification

Bricks used shall be classified on the basis of their average compressive strength which should be between 10N/mm^2 to 12.5 N/mm^2. The bricks shall have smooth rectangular faces with sharp corner and shall be uniform in colour and emit clear ringing sound when struck.

18.4 Sampling and Criteria for Conformity

Samples of bricks and criteria for conformity of common bricks shall be done in accordance with the procedure laid down in IS: 5454.

18.4.1 Physical Requirements

The sample collected should satisfy the following:

(i) Dimensional tolerance. The dimension tolerance of bricks when tested should have.

  (a) Length 372 to 388 cm (380±8cm)

  (b) Width 176 to 184 cm (180±4cm)

  (c) Height 176 to 184 cm (180±4cm)

(ii) Compressive strength- The bricks when tested in accordance with procedure laid down in the IS: 3495 (part-1) shall have minimum compressive strength as given above.

(iii) Water absorption – The bricks when tested in accordance with procedure laid down in the IS: 3495 (part-2) after immersion in the cold water for 24 hrs, the water absorption should not be more then 15 percent by weight.

(iv) Efflorescence. The bricks when tested in accordance with procedure laid down in the IS: 3495 (part-3) the rating of efflorescence should not be more than moderate.

18.5 Mortar for Brickwork

The mortar for the brick work shall be as specified, and conform to accepted standards or as specified in construction drawing. Dry mortar shall be prepared by using sand corresponding to one bag of cement measured by batching boxes and then spreading one bag of cement over it. The mixture shall then be thoroughly mixed and then specified quantity of the water is added. Mortar once mixed shall be used within 30 minutes. In no case the old mortar be mixed with the new mortar.

18.6 Laying of Bricks

(i) Bricks shall be laid in English Bond unless otherwise specified. All loose materials, dirt and set lumps of mortar which may be lying over the surface on which brick work is to be freshly started, shall be removed with a wire brush and surface wetted. Bricks shall be laid on a full bed of mortar, when laying, each brick shall be properly bedded and set in position by gently pressing with the handle of a trowel, its inside face shall be buttered with mortar before the next brick is laid and pressed against it. Joints shall be fully filled and packed with mortar such that no hollow space is left inside the joints.

(ii) The walls shall be taken up truly in plump of true to the required better where specified. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in the alternate course shall come directly one over the other.

(iii) The brick work shall be built in uniform layers. No part of the wall during its construction shall rise more than one meter above the general construction level. Parts of wall left at different levels shall be raked back at an angle of 45 degrees or less with the horizontal

(iv) All pipe fittings and specials, spouts, hold fasts and other fixtures which are required to be built into the walls shall be embedded, as specified, in their correct position as the work proceeds unless otherwise directed by the Engineer.

(v) Bricks shall be laid with frog (where provided) up. However, when top course is exposed, bricks shall be laid with frog down. For the bricks to be laid with frog down, the frog shall be filled with mortar before placing the bricks in position.

(vi) Bricks shall be soaked in water before use for sufficient period for the water to just penetrate the whole depth of the bricks. Alternatively bricks may be adequately soaked in stacks by profusely spraying with clean water at regular intervals for a period not less than six hours. When the bricks are soaked they shall be removed from the tank sufficiently early so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not again spoiled by dirt earth etc.

(vii) Work of cutting chases, wherever required to be made in the walls for housing GI pipe, CI pipe or any other fixtures shall be carried out in various locations as per guidelines given below:

(a) As far as possible services should be planned with the help of vertical chases. Horizontal chases should be avoided.

(b) The depths of vertical chases and horizontal chases shall not exceed one-third and one-sixth of the thickness of the masonry respectively.

(c) Horizontal chases when unavoidable should be located in the upper or lower one-third of height of storey and not more than three chases should be permitted in any stretch of a wall. No continuous horizontal chase shall exceed one meter in length. Where unavoidable, stresses in the affected area should be checked and kept within the permissible limits.

(d) Vertical chases should not be closer than 2m in any stretch of a wall. Theses shall be kept away from bearings of beams and lintels. If unavoidable, stresses in the affected area should be checked and kept within permissible limits.

18.7 Curing

The brick work shall be constantly kept moist on all faces for a minimum period of seven days. Brick work done during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.

18.8 Scaffolding

Scaffolding, wherever required, shall be strong to withstand all dead, live and impact loads which are likely to come on them. Scaffolding shall be provided to allow easy approach to every part of the work. Any hole made for scaffolding should be made good.

18.9 Measurements and Payments

Brick work shall be measured in m^3 unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01 m i.e. 1 cm. Areas shall be calculated to the nearest 0.01 m^2 and the cubic contents shall be worked out to the nearest 0.01m^3. The brick work carried out as per the approved drawings shall be measured and paid at the unit rate entered in BOQ. The quoted rate shall include the cost of all

leads and lifts, bricks, cement, mortar, labour, scaffolding, wastage, curing, testing etc., complete.

CHAPTER-19
SAFETY PRECAUTIONS

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19.1 General

(i) These safety provisions shall be brought to the notice of all concerned by display on a notice board at a prominent place on the site. The person responsible for compliance of the safety code shall be named therein by the contractor.

(ii) To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the contractor shall be open to inspection by the labour officer or the Engineer.

(iii) The contractor shall observe all safety precautions to control the noise on all sites and also provide all workmen deployed in the affected areas with the necessary equipment for safety against noise.

(iv) When the work is done near any place where there is risk of drowning, all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provisions shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

(v) The contractor shall at all time exercise reasonable and proper precautions for the safety of the people on the works and shall comply with the provisions of current safety laws and building and construction codes of the GoN as may be applicable. All machinery and equipment and other sources of physical hazards shall be properly guarded.

(vi) The contractor shall have a full time staff exclusively in-charge of securing the safety of the work ensuring that all safety regulations are followed and in-charge of indoctrinations and teaching courses on safety to the work force.

(vii) The contractor shall provide all necessary fencing and lights to protect the public from accidents and shall be bound to bear all the expenses of defence of every suit, action and other proceedings at Law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action and proceedings to any such persons or which may, with the consent of the contractor, be paid to compromise any claim by any person.

(viii) When any work is carried on, which is likely to affect the security or stability of an installation or structure or any part thereof and endanger any person employed, all practicable precautions shall be taken by shoring or otherwise to prevent collapse of structure or fall of any part thereof and thus remove the cause of danger to such structures and the persons employed.

(ix) For persons engaged in handling of corrosive materials, adequate equipment shall be provided.

(x) Where, in connection with any grinding, cleaning, spraying or manipulation of any material, there is emission of any dust or fume of such character and to

such extent as is likely to be injurious to the health of persons employed, all practical measures shall be taken by securing adequate ventilation or by the provisions and use of suitable respirators or otherwise to prevent inhalation of such dust and fume.

(xi) Within 28 days from the date of issue of Notification of Award, the contractor shall submit, in writing, his proposal for a comprehensive safety programme covering all aspects of the Works.

(xii) This safety programme shall detail policies, procedures, and plans, which the contractor intends to implement to ensure the safety and health of his employees. It shall comply with the standards and regulations in force applicable to construction safety.

(xiii) The contractor shall designate a competent employee specially trained and experienced to act as safety officer, who will administer and be responsible for the implementation of the safety program. He shall carry out frequent and regular safety inspections of the working areas, materials, and equipment. The name and qualifications of the safety officer shall be submitted for approval to the Engineer prior to his appointment.

(xiv) The contractor shall be responsible for enforcement of the health and safety provisions for his subcontractors to be employed at the site.

(xv) Prior to the start of any major construction activity or hazardous operation, the contractor shall submit to the Engineer for approval, a specific plan for safety precautions covering such operation.

(xvi) All accidental occurrences with serious accident potential such as major equipment failures, contact with high-voltage lines, exposure to hazardous materials, slides, cave-ins, etc., shall be immediately reported to the Engineer.

(xvii) All serious and fatal injuries and diseases caused by the progress of work shall be immediately investigated by the contractor and a comprehensive report shall be submitted to the Engineer.

(xviii) In case of a fatal accident, only rescue and emergency teams and operations shall be permitted at the place of the occurrence until the Engineer gives permission to resume normal operations.

19.2 Safety Equipment

(i) All necessary personal safety equipment as considered adequate by the Engineer shall be kept available for the use of the persons employed on the site and maintained in condition suitable for immediate use, and the contractor shall take adequate steps to ensure proper use of equipment by those concerned.

(ii) Workers employed on mixing asphaltic materials, cement mortar and cement

concrete shall be provided with protective footwear and protective goggles.

(iii) Those engaged in mixing or stacking of cement bags or any materials which is injurious to eyes shall be provided with protective goggles.

(iv) Those engaged in welding works shall be provided with welder's protective eye shields.

(v) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

19.3 Contractor's Employee

About his employees, the contractor shall ensure as follows:

(i) Each employee shall be provided initial indoctrination regarding safety by the contractor so as to enable him to conduct his work in a safe manner.

(ii) No employee shall be given a new assignment of work unfamiliar to him without proper introduction as to the hazardous incident thereto, both to himself and his fellow employees.

(iii) Under no circumstances shall an employee hurry or take unnecessary chances when working under hazardous conditions.

(iv) Employees shall not leave naked fires unattended adequate fire fighting equipment shall be provided at crucial locations.

(v) Employees under the influence of any intoxicating beverage, even to the slightest degree, shall not be permitted to remain on work.

(vi) There shall be a suitable arrangement on every site for rendering prompt and sufficient first aid to the injured under the guidance of the medical officer.

(vii) The stair cases and passage ways shall be adequately lighted.

(viii) The employees, when working around moving machinery, shall not be permitted to wear loose garments safety shoes are recommended when working in shops or places where materials or tools are likely to fall. Only experienced workers shall be permitted to go behind guard rails or to clean around energized or moving equipment.

(ix) The employees shall use the standard protection equipment intended for each job. Each piece of equipment shall be inspected before and after it is used.

19.4 Scaffolding, Working Platforms and Gangways

(i) Suitable scaffolds shall be provided for workmen for all works that cannot

safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra workman shall be engaged for holding the ladder. If the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 0.25 to 1 (0.25 horizontal and 1 vertical)

(ii) Scaffolding or staging more than 3.6m above the ground or erected floor, and hung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured atleast 0.9m high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of the materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the structure.

(iii) Working platform, gangways and stairways shall be so constructed that they do not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6m above ground level or floor level, they shall be closely boarded, and shall have adequate width and shall be suitably fastened as described above.

(iv) Every opening in the floor of a structure or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 0.9m. Employees working on steep slopes or otherwise subject to possible falls from levels not protected by guardrails or safety nets, shall be secured by safety belts and lifelines.

(v) Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9.0m in length while the width between side rails in hung ladder shall, in no case, be less than 28cm. for ladder upto and including 3.0m in length. For longer ladders, this width shall be increased at least by 6mm for each additional 30 cm of length. Uniform step spacing shall not exceed 30 cm. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.

(vi) All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work

19.5 Excavation and trenching

All trenches, 1.2m or more in depth, shall at all times, be supplied with at least

one ladder for each 30 meters length or fraction thereof. Ladder shall be extended from bottom of the trench to at least 0.9m above the surface of the ground. The sides of the trenches which are 1.5m or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5m of the edges of the trench or half of the depth by the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.

19.6 Demolition

Before any demolition work is commenced and also during the process of the work:

(i) All roads and open areas adjacent to the site shall either be closed or suitably protected.

(ii) No electric cable or apparatus which is liable to be a source of danger over a cable or apparatus used by the operator shall remain electrically charged

(iii) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the structure shall be overloaded with debris or material as to render it unsafe.

19.7 Underground Works

(i) In addition to above, the contractor shall take the following specific precautions for the underground works:

a) All precautions regarding safety of personnel working in tunnels/caverns/shafts, in connection with the handling of electrical installations, loadings, blasting and seepage water etc., as specified in the relevant stipulations of IS codes shall be taken by the contractor in order to ensure safe underground working. He shall also provide adequate medical, drinking water, sanitation, lighting and ventilation facilities.

b) Emergency material shall be provided at each underground excavation heading. This equipment shall include but not be limited to the following:

- 3 stretchers
- 3 woolen blankets
- 2 appliances for artificial breathing

- 1 oxygen flask
- 3 explosion-proof lamps
- wound dressing and disinfection material
- anti-pain injections
- gas masks

(ii) At least two members of the rescue team as described hereinafter, properly instructed and trained in there rescue procedures, shall be in each crew working underground.

(iii) Prior to the commencement of construction, the contractor shall organize and train a rescue team composed of his employees. This rescue team shall be capable to render help after accidents caused by fire, gas explosion and avalanche etc.

(iv) The rescue team shall be organized in such a way that sufficient number of measures is ready for action at any time until the completion of works.

(v) The rescue team members shall be instructed and trained for their task by a qualified and experienced person. If required, the contractor shall hire an outside specialist to perform such training. A refresher training for all members of the rescue team shall be conducted at least every six months.

(vi) Each rescue team member shall be skilled in giving the first aid, dealing with the appliances for artificial respiration and fire fighting equipment and shall possess a good local knowledge. Adequate equipment for reaching even the remotest working area shall be at their disposal.

(vii) The contractor shall submit the details of the proposed rescue team organization to the Engineer for approval.

19.8 Painting Works

(i) The contractor shall not employ men below the age of 18 years and the following precautions shall be taken:

a) No paint containing lead, sulphate of lead or products containing their pigments shall be used except in the form of paste or readymade paint.

b) Suitable face masks shall be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

c) Overalls shall be supplied by the contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.

d) Measures shall be taken, wherever required, in order to prevent danger

arising from the application of paint in the form of spray

e) Measures shall be taken, whenever practicable, to prevent danger arising out from dust caused by dry rubbing down and scrapping

f) Suitable arrangements shall be made to prevent clothing put off during working hours, being spoiled by painting materials

(ii) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by a medical officer appointed by the competent authority of employer .

(iii) Employer, when necessary, may ask contractor to arrange for medical examination of workers.

(iv) Instructions with regard to special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

19.9 Hoisting Machines and Shackles

Use of hoisting machines and shackle including their attachments, anchorage and supports shall conform to the following standards or conditions:

a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.

b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength and free from patent defects.

c) Every crane driver or hoisting appliance operator shall be properly qualified for his job.

d) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gears referred to above shall be plainly marked with the safe working load.

e) In case of hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing. The capacity of the hoisting machines shall be periodically checked.

f) The contractor shall notify the safe working load of the machines to the Engineer whenever he brings any machinery to site of work and shall get it verified by the Engineer or his representative.

g) Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards. Hoisting appliances shall be provided with such means as shall reduce to the minimum, the risk of accidental descent of the load, adequate precautions shall be taken to reduce to minimum the risk of any part of a suspended load becoming accidentally displaced. When workmen are employed on or near electrical installations which are already energized insulating mats, wearing apparel, such as gloves, sleeves and boot, as may be necessary, shall be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

19.10 Fire Prevention and Fire Fighting Arrangements

19.10.1 Fire Prevention Precautions

(i) All construction areas and storage yards shall be kept clean and well arranged.

(ii) A clear space of 15 meters around the outer boundary of saw mill and lumber storage area may be provided. All lumber shall be stored in sections with fire breaks with a distance of 15 meters between consecutive sections.

(iii) All combustible waste material, wood scaling and soiled rags etc., shall be removed daily and burnt in suitable burning areas. The saw mill and lumber yard shall be kept free from accumulation of combustible debris.

(iv) Fires, welding, flame cutting shall in general not be permitted in combustible areas. Fires and open flame devices shall not be left unattended.

(v) Smoking shall be prohibited in all fire prone areas, flammable material storages viz. carpentry, paint shops, garages, service stations etc. “No Smoking” signs shall be pasted on all such areas.

(vi) Accumulation of flammable liquids on floors walkways etc. should be prohibited. All spills of flammable liquids shall be cleaned up immediately.

(vii) Smoke pipes from diesel engines passing through roof of combustible material e.g. in compressor stations on various sites shall be insulated by asbestos. All joints of smoke pipe shall be riveted, welded or otherwise securely fastened together and supported to prevent accidental displacement or separation. The joints shall not be leaky.

(viii) Flammable liquids, lubricants etc., shall be handled and transported in safety containers and drums which can be kept tightly capped.

(ix) Storage of fuels and other flammable materials and liquids shall be set not less than 100m away from the works and permanent installations. All storage installations and tanks shall conform to the regulations set out in relevant

standards.

(x) Petrol or other flammable liquids with a flash point below 100 degrees Centigrade shall not be used for cleaning purposes.

(xi) Oxygen cylinders shall not be stored with combustible materials.

(xii) All electric installations shall be properly earthed. Repairs shall not be made on electrical circuits until the circuit has been de-energized.

19.10.2 Fire-fighting Arrangements

(i) Fire extinguishers and fire buckets, painted red, shall be provided at all fire hazardous locations viz., Batching and mixing plant, winch houses, workshops, store yards, saw-mill, switch gear room, compressor stations, office establishments etc. The extinguishers shall be inspected, serviced and maintained in accordance with manufacturer's instructions. The inspection shall be evidenced by notations on tag attached to the extinguisher.

(ii) Full reliance shall never be placed on portable hand extinguishers as all of these have a very limited capacity. Water, in ample quantity and under adequate pressure, shall always be available for firefighting.

(iii) Where a group of work points are located beyond the range of protection from a public water supply, the installation of a water system for private fire protection shall be warranted.

(iv) Evacuation facilities and fire exit shall be provided at all locations featuring fire hazards.

(v) Siren or other suitable fire alarm arrangement shall be made on all sites. Warning signs shall be pasted at all locations having fire hazards.

(vi) All staff shall be conversant with the use of all types of fire extinguishing apparatuses.

(vii) Demonstrations and training in fire fighting shall be conducted at sufficient intervals to ensure that sufficient personnel are familiar with and are capable of operating firefighting equipment.

19.11 Safety Codes/Standards

(i) In addition to instructions contained in this chapter, the safety regulations contained in the following latest Indian standards or, where not covered by these standards, to the equivalent International standards shall also be applicable.

IS:3764	Code of safety for Excavation Works
IS:4756	Safety Code for Tunneling Work
IS:7293	Safety Code for Working With Construction Machinery
IS:7969	Safety Code for Handling and Storage of Building Materials
IS:4081	Safety Code for Blasting and Related Drilling Operations
IS:3696 (Part-I)	Safety Code for Scaffolds & Ladders Part-I Scaffolds
IS:3696 (Part-II)	Scaffolds & Ladders- Code of Safety Part- 2 Ladders
IS:4138	Safety Code for Working in Compressed Air
IS:4130	Safety Code for Demolition of Building
IS:5916	Safety Code for Construction Involving Use of Hot Bituminous Materials.
IS : 3016	Code of practice for Fire Precautions In Welding and Cutting Operations
IS:5878(Part-II)	Code of Practice for Construction of Tunnels- Part II : Underground Excavation in Rock - Section 1 : Drilling and Blasting Section 2 Ventilation, Lighting, Mucking and Dewatering

(ii) Notwithstanding the above provisions, the Engineer may require the contractor to follow any other act or rules in force in place of execution of work in respect of safety precautions so as to ensure the safety of the workmen, constructional plant and the works. The contractor shall promptly comply with all such safety requirements.

19.12 Dust Abatement

During the performance of the work and any operations appurtenant thereto, the contractor shall carry out proper and efficient measures, such as sprinkling with water or other means, whenever necessary to reduce the dust nuisance, and to prevent dust which has originated from his operations from damaging crops, cultivated fields, and dwellings, or causing a nuisance to persons. The contractor will be held liable for any damage resulting from dust originating from his operations.

19.13 Pollution of Streams and Rivers

(i) The contractor shall take all possible steps to prevent pollution of streams, rivers, and other water supplies, at or in the vicinity of the site and shall comply with applicable laws, orders and regulations in force in place of execution of work concerning the control and abatement of water pollution.

(ii) Under no circumstances shall the sewage from the camps, or other contaminated water, be released directly into river or other natural streams or any open areas without prior treatment.

19.14 Penalty for Non-Observance of Safety Measures

The Engineer can levy a penalty on each reported occasion of non-observance of the requisite safety measures as provided in General Conditions of Contract.

19.15 Measurement and Payments

(i) No extra measurement for payment or payment whatsoever will be made for the safety precautions required to be provided by the contractor and the entire cost thereof shall be included in the Unit Prices for other items of the works.

(ii) Any repair work or any indemnities required due to contractor's non-compliance with the safety requirements shall be at the contractor's expense. Nothing contained in these specifications shall prevent contractor from providing, at its own cost, such amount of rock reinforcement, steel ribs or other supports for ensuring safety of excavation performed under the contract, as it may consider necessary, in excess of that specified by Engineer.

CHAPTER-20
QUALITY ASSURANCE

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20.1 Quality Assurance in Execution of Works

(1) The contractor shall establish staff, equip and operate a comprehensive quality assurance set-up at the site during the full period of the Works. The principal responsibility and duty of this set-up shall be to ensure that all work carried out and materials produced or supplied by the contractor comply fully with the Specifications.

(2) With his tender, the Bidder shall submit his detailed proposal (in terms of experienced supervisory staff, trained workmen, procedures of work, equipments, obtaining support from outside agencies) for achieving quality in respect of the minimum following:

- Underground and open excavation particularly quality control in blasting and minimization of over breaks and damage to surrounding rock.
- Maintaining clean working environment inside underground work with particular reference to lighting, ventilation and dewatering.
- Rock support installations particularly the grouting of rock bolts / rock anchors / tendons in surface and underground works.
- Workmanship in shotcrete placement.
- Workmanship in concrete placement in surface and underground works.
- Grouting activities particularly the mix designs and selection of mixes for particular application.
- Final clean up.

The bidder's proposal shall be specific enough to assure that all works are executed in a professional manner and bidder has included in his bid the provision of employment or adoption of the best international practices of construction in the implementation of the work.

(3) At the time of award of work, the bidder's proposal at the time of tender shall be confirmed again and shall be improved, if so required.

(4) Immediately after the award of work, during mobilization phase, the contractor shall take systematic steps to implement all the proposals given by him for achieving the desired quality in construction.

(5) During course of execution, the quality of the work in progress shall be reviewed atleast once in 3 months in the Quality Assurance meeting specifically called by the Engineer and participated by contractors Project organisation. In case Engineer is not satisfied with the resources employed *vis-à-vis'* the commitments made in the proposal, the contractor shall take additional steps to supplement his efforts.

20.2 Control of the Progress of Work

(i) Close progress control, and the preparation of corresponding progress reports, shall be an important part of the contractor's quality control responsibilities. The contractor must at all times provide the Engineer with up to date information on the progress of work and must without delay bring to the attention of the Engineer all delays or occurrences which could lead to delay or additional costs.

(ii) The contractor shall submit detailed monthly progress reports to the Engineer, in which the contractual programme for the works is updated and information is given on the quantitative completion of civil works (in the form of tables indicating the quantities of completed work).

(iii) The monthly progress reports shall give full details of any delays to work in progress or planned, delays in transport to/from the site, together with detailed proposals for overcoming or preventing delays, and for regaining any lost time.

(iv) The contractor shall at any time, at the request of the Engineer, submit detailed reports on particular matters relating to the execution and progress of the works, if such reports are required in order to assess the quality or progress of specific activities or works.

20.3 Contractor's Quality Control Staff

(i) The contractor shall assign one experienced engineer to site as full-time quality control manager, responsible with complying with all requirements of Technical Specifications.

(ii) The experience and qualifications of this engineer shall be given in the contractor's tender and shall be subject to the approval of the Engineer.

(iii) The positions, qualifications and duties, of the contractor's quality control staff shall be indicated in the QC organization plan, and shall likewise be subject to approval by the Engineer. As a minimum, the contractor shall appoint one qualified and experienced engineer / geologist to be responsible for quality control of each of the following works:

(a) Tail Race Pond ,Outfall & intake excavation

(b) Head Race Tunnel Excavation

At the end of each month, the Contactor shall report to the Engineer the name and qualifications the Contractor's Quality staff alonwith the time since when employed with the Contractor.

20.4 Contractor's Laboratories

(i) The contractor shall establish, equip and operate on site laboratories for the testing of the following principal construction materials:

a) Concrete, including testing of sand, aggregates, cement, water and admixtures.

b) Any site testing and/or calibration of monitoring instrument.

(ii) The number of samples to be tested, and the timing of testing, shall be as given elsewhere in these specifications or as per relevant Indian/International Standards or as directed by the Engineer

(iii) The staff of the contractor's laboratory shall have proven experience in similar previous work and their qualifications shall be subject to approval by the Engineer.

(iv) Complete records shall be kept of all laboratory tests carried out and shall be available at any time to the Engineer on request.

(v) The Engineer shall be permitted at any time and without notice to observe tests being carried out in any of the contractor's laboratories, to inspect equipment or to study results.

20.5 Material Delivered to Site

(i) The contractor's quality control staff shall keep full records of all materials delivered to site for use in the Works, and of all tests made on such materials either prior to or following delivery to site.

(ii) These records shall be available at all times to the Engineer, together with any factory testing certification.

20.6 Measurement and Payments

No measurement for payment will be made for any of the contractor's QC (Quality Control) activities required in this Section. All costs of these activities will be included in the Unit Prices for work listed in the Bill of Quantity.

CHAPTER-21

COMMISSIONING

INDEX

21.1 General

(i) The civil contractor will be required to co-ordinate his work with (HM Contractor) and make due allowance for the installation, testing and commissioning of items of hydro-mechanical equipment to be supplied under HM contract and will be required to co-operate with and assist the respective contractor/sub-contractor/joint venture partner in the work.

(ii) The periods for the installation, testing and commissioning of HM equipment and works shall be as per the contractual programme specified in contracts with respective contractors which shall also be intimated to civil contractor for the purpose of coordination.

(iii) During the installation, testing and commissioning of equipment the civil contractor will allow full access to the staff of the respective contractor/sub-contractor/joint venture partner in the work of HM contractor and for their equipment and materials and must make full allowance in his work activities and programme for any delays, restrictions or changes of working methods which may result from this requirement.

(iv) The civil contractor will be expected to agree with the joint venture partner in the work/respective contractor/sub contractor providing him with materials, consumables and electric power as these may be needed during the installation and testing of hydro-mechanical equipment, at costs to be agreed directly between them and at no cost to Employer.

(v) The civil contractor will be expected to make available to the sub contractor/joint venture partner as available storage space for equipment items and plant during the installation of hydro-mechanical equipment, again at costs to be agreed directly between them and at no cost to Employer.

21.2 Hydro-Mechanical Equipment to be Installed

The principal items of hydro-mechanical equipment constructed in the HM contract which are to be installed in civil structures, shall include but not limited to the following:

a) Tail Race Pond Outfall Gates , including hoisting equipment.

b) Lower Arun Intake gates.

In addition to above the contractor shall also have to coordinate his works with and make due allowances for the works being executed in the vicinity by other contractor.

21.3 Testing of Equipment

(i) The civil contractor will work together as required with the HM contractor and any sub-contractors during the testing of all items of newly-installed hydro-mechanical equipment.

(ii) Should this testing reveal any defects or inadequacies of the works carried out by the civil contractor, the latter will immediately act to remedy or make good these defects or inadequacies, to the satisfaction of the Engineer, in such a way that the testing by the HM contractor is not delayed.

(iii) The civil contractor shall contribute any data or other information needed by the HM contractor or the Engineer for inclusion in testing report or commissioning certificates.

21.4 Commissioning of the Project as a Whole

The civil contractor together with the HM contractor shall fully participate (and co-operate with the Engineer) during the time of final commissioning of the project which shall include filling of the water conductor system and commissioning of individual units in the Arun-3 Power House.

21.5 Measurement and Payments

There will be no measurement for payment for any of the activities related to equipment commissioning as well as commissioning of the Project as a whole. All costs related thereof will be deemed to be covered in the Unit Rates given in the Bill of Quantity.

CHAPTER-22

ROAD WORKS

DELETED

CHAPTER-23

METALWORKS

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23.1. Scope of Work

(i) The specifications described herein-under cover all labour, materials, plant, equipment and services related to the supply, handling, fabrication, transportation, erection, painting (wherever applicable), testing of various metalworks shown on the drawings or as directed by the Engineer to be carried out by the contractor under this contract.

(ii) The work shall be done strictly as per fabrication/erection drawings approved by the Engineer. These fabrication/erection drawings shall be prepared by the contractor and shall be based on the drawings issued by the Engineer with additions/alterations and modifications, if any from time to time. However, this approval by the Engineer of the contractor's drawings shall not be held to relieve the contractor of any part of his obligations to meet all the requirements of the contract.

(iii) The Engineer will have the right to ask the contractor to make any changes in his fabrication/erection drawings which, in the opinion of the Engineer, may be necessary to make the finished construction conform to the requirements and intents of these specifications and drawings inclusive of all modifications, revisions etc., which may be made and informed to him from time to time during execution of works.

(iv) This section covers the following items:

(a) Watertight steel covers, frames and gratings.

(b) Handrails and steel stairs

(c) Steel liner in dam sluices/spillways & other works

(d) Steel pipes and tubes

(e) Steel rungs and ladders

(f) Miscellaeous steel sections

(v) Unless otherwise stated or shown, all miscellaneous metalwork shall be fabricated from carbon steel sections, plates and bars complying with the relevant Indian standards.

(vi) Unless otherwise stated or shown, all miscellaneous metalwork shall be painted as specified herein-after.

(vii) Contractor shall be responsible for material quality control and shall ensure compliance of the metalworks to the relevant standards and these specifications.

23.2 Standards

The design, fabrication, installation, painting (wherever applicable) and testing of steel liner shells, shall conform to the following Indian Standards or where not covered by these standards, to the equivalent International Standards:

IS:808	Dimensions for Hot Rolled Steel Beam,Column,Channel and Angle Sections
IS:2062	Hot Rolled Medium and High Tensile Structural Steel-Specifications
IS:1161	Steel Tubes For Structural Purposes - Specification
IS:3589	Steel pipes for water and sewage (168.3 to 2540 mm outside dimater)-Specification
IS :4736	Specification for hot-dip zinc coatings on mild steel tubes
IS:9297	Recommendation for lighting ,ventialtions and other facilities inside dam
IS:9862	Specification for ready mixed paint ,brushing ,bituminous, black,lead free,acid, alkali,water and chlorine testing
IS:2825-1969 (Reaffirmed 2002)	Code for Unfired Pressure Vessels
SP:12:1975	ISI Handbook for gas welders
	ISI Handbook of Manual Metal-arc Welding for Welders

23.3 Submittals

(i) The contractor shall supply certificates of compliance with specified Indian standards or other relevant standards for all materials supplied to the works. Manufacturer's catalogues and samples of materials proposed for incorporation in the works shall be submitted for approval, if requested by the Engineer.

(ii) From the information given in the bid document and on the drawings, the contractor shall prepare, prior to the manufacture, his own shop drawings showing sections and plans of all part, assemblies, connections and supports for all metalwork shown on the drawings. Two copies of each drawing, calculation sheet and schedule of materials shall be submitted to the Engineer for comments and approval. Within 30 days from the submission, the Engineer will return such drawings either as approved or with requests for modifications. Within 14 days the contractor shall revise the drawings, calculations and schedules accordingly and return a new set (again in two copies) of these for the final approval.

(iii) After the final approval, the contractor shall deliver editable soft copy and two hard copies of the documents to the Engineer.

(iv) The approval of shop drawings and calculations shall not in any way relieve the contractor of his responsibility and obligations under this contract, particularly those relating to the adequacy and accuracy of the final product. Any materials order or fabrication work performed, before the contractor's drawings are approved, will be at his own risk.

(v) The contractor shall not be entitled to any time extension based upon the rejection of his designs or detail drawings if these fail to conform to sound engineering practices or to the stipulations contained in these specifications.

23.4 General procedures for fabrication and Erection of metal works

23.4.1 Fabrication

(i) The work shall be shop fitted and shop assembled where possible, and shall conform to the details on approved contractor's shop drawings.

(ii) Workmanship shall conform to the best modern shop and field practice. All joints and intersecting member shall be accurately fitted and all work shall be fabricated in true planes (to tolerances as provided on drawings) with adequate fastenings.

(iii) Plates and steel sections shall be perfectly straight with smooth surfaces. Edges shall be sharp, clean and without burrs after the cutting. Thick plates may be flame cut, provided that the material is not damaged and that the edges of the cut are ground clean or machined. Plates shall be cold-rolled. Correction of bent members by heavy blows shall be avoided. Special care shall be taken when hot-rolling becomes necessary.

(iv) All members shall be carefully and accurately assembled by welding, screws, bolts, or rivets as approved. The joints shall be filled, milled, or machined as necessary to provide closed and perfect connections. All frames shall be provided with suitable bracing to maintain alignment during transport. Units shall not be subject to overstressing during transport and erection. Hammering which would injure or distort the members will not be accepted.

(v) All fastening, anchors and accessories required for fabrication and erection of the work shall be provided. Exposed fastenings shall be kept to an absolute minimum evenly spaced and neatly set out. Wood plugs shall not be permitted.

(vi) The contractor shall check the actual dimension and shapes of existing concrete openings before fabricating steel frames and metal supporting parts of steel cover and gratings.

23.4.2 Welding

(i) All welding shall be carried out by experienced welders using the shielded-arc method as described in the SP 12 of ISI "Handbook for Gas Welders" and ISI "Handbook of Manual Metal Arc Welding for welders".

(ii) Welding rods shall be of the heavily coated type design for all position welding, and the size, type and manufacture of the rods shall require the consent of the Engineer.

(iii) All welding shall be continuous along the entire line of contact, except where tack welding is permitted. Beveling of the materials shall be done as shown on the approved shop drawings and shall be finished to a smooth and true finish with an automatic gas cutter or grinder. The use of manual gas cutters shall require the consent of the Engineer.

(iv) The surface of the working materials shall be free from slag, moisture, rust oil, pain or other impurities. Mill scale which cannot be removed with a stiff wire brush will be allowed to remain.

(v) The face of welds shall be smooth and form a uniform bead. The size and thickness of weld shall neither be less than specified, nor there an excessive build-up or marked irregularities in the surface appearance.

(vi) Blow holes, slag, overlap, undercut and unsatisfactory melting of welded joints shall be removed with grinders or by other means and then re-welded. Due care shall be taken to protect the surrounding part from any injury or damage. Deformation of members resulting from welding shall be repaired by an approved mechanical method.

(vii) Welding of aluminum shall be done employing a “parent metal” or other approved filler rods. Surfaces which have been previously treated such as anodizing shall not be welded.

(viii) The contractor shall propose the type and carry out the non- destructive testing of the welds as approved. All joints which are to be watertight shall be tested by penetrant.

23.4.3 Surface Finish and Corrosion Protection

23.4.3.1 Painting

(i) Paints used for both prime and finish coats shall be two component epoxy based, shall be obtained from the same manufacturer and shall be the best quality of their kind. They shall be suitable for application in environments were the relative humidity may exceed 90%. The contractor shall submit samples of all paints he proposes to use to the Engineer for approval, who will select the colour of the finish coats.

(ii) Prior to painting, steel surfaces shall be sand blasted down to rust degree SA 2-1/2 according to SIS Standard 055900,to remove all mill scale, weld splatter, rust and any other deleterious material. Oil and grease shall be removed by an approved solvent. The surface shall be wiped clean of any dust prior to priming.

(iii) Immediately after cleaning, steelwork shall receive two coats of two components zinc epoxy primer, each of dry film thickness 0.05mm. Any primer applied surface that shows signs of rusting, flaking, powering or peeling of the prime coat, or any finish coat, shall be sandblasted to remove the paint bare to the metal as described above and repainted.

(iv) After priming, steelwork shall receive a further two coats of two components epoxy based paint, each of dry film thickness 0.08mm. The total theoretical thickness of paint applied including prime coats shall be 0.26mm but in no case less than 0.22mm.

(v) All painting work shall be carried out in accordance with the manufacturers recommendations in a clean dust-free environment with temperature and humidity controlled to comply with these specifications and the recommendations of the paint manufacturer. All the surrounding works shall be protected in a suitable manner from paint drops and overspray. All smeared and damaged surfaces shall be cleaned or repaired.

(vi) After erection of painted miscellaneous metalwork the contractor shall make good any damage to the paint coating in accordance with the manufacturer's recommendations. The Engineer may require items which are badly damaged to be removed, returned to the shop and repainted.

23.4.4 Fasteners

(i) Fasteners for miscellaneous metalwork including bolts, anchor bolts, cap screws and nuts shall be of stainless steel unless otherwise stated or shown in drawings approved by Engineer.

(ii) Study and anchors for fixing metalwork to concrete shall be of stainless steel and shall be of the expanding type. Grouted or resin types shall require the consent of the Engineer.

23.4.5 Installation

(i) All items of the miscellaneous metalwork shall be installed in correct position and alignment. Damaged or defective materials shall not be installed. Damaged or defective areas of paint shall be cleaned and repaired as directed by the Engineer.

(ii) Metalwork to be embedded in concrete shall be located accurately and shall be held in correct position and alignment during concrete placing and setting of the concrete.

(iii) Unless otherwise provided, the anchor bolts shall be set and held in position before concrete is placed. Where it is impractical to embed anchor bolts or anchors for the comparatively light metalwork before the concrete is placed, and where it is necessary to anchor parts but inserts or anchor bolts have not been provided, holes shall be drilled in the concrete an approved expansion anchors shall be installed. All holes for the anchors shall be straight and true to the

diameter recommended by the manufacturer of the expansion anchors. If necessary, the contractor shall use diamond bits to achieve true, fitting holes. When drilling water is used, surfaces of concrete permanently expose shall be cleaned immediately to prevent discoloration by the drilling water and cuttings.

(iv) Supports and base plates shall be leveled or aligned accurately and rigidly secured in place. Adjustment with steel shims shall be done as necessary. All spaces under the supports or base plates shall be filled with concrete or shall be grouted as specified in the chapter "Cement Concrete".

(v) Each complete unit shall be serviced and tested after installation. The servicing shall include lubricating, adjusting, cleaning all parts, and all other work and material required for operation. After each unit has been serviced, it shall be given an operation test, and adjustments shall be made until the operation of the unit is approved by the Engineer.

23.5 Metalworks Supplied and Installed by the Contractor

23.5.1 Watertight Steel Covers, Frames and Gratings.

(i) The Contractor shall supply and install all watertight steel hatch covers, frames, grating for cable channels, drains etc. as required by the Engineer or as shown on the construction drawings and specified herein. All items shall be fabricated according to shop drawing prepared by the contractor in the course of works.

(ii) Covers shall be manufactured from 6mm steel checker plate with reinforcing steel sections where required, steel flats and lifting handles.

(iii) Steel gratings shall consist of 25mm deep by 2mm thick welded steel flats. Mesh size shall be 30x30mm. Frames and steel sections as supports for grating shall consist of steel angles or channel sections fixed in the concrete. Frames shall be adjusted during installation to ensure good fit and even bearing for the grating. Gratings shall be placed flush with finished floors.

(iv) Steel covers, frames and reinforcing members for supporting gratings shall be painted as specified above in this chapter.

23.5.2 Handrails and Steel Stairs

(i) The contractor shall supply and install steel stair and handrails fabricated from MS steel pipes/steel sections as shown on the bid drawings or directed by Engineer. Material for steel pipes/steel sections shall be of standard weight and shall conform to relevant IS codes. All items shall be fabricated according to shop drawings prepared by the contractor and approved by Engineer in the course of works.

(ii) Handrails shall be installed following the slopes and in the positions shown on the construction drawings and shall be supported to avoid movement when placing

concrete in the blockouts. Handrails and steel stairs shall be painted as specified above in this section.

23.5.3 Steel pipes and tubes

(i) The Contractor shall supply and install steel pipes of various diameters and fittings in the positions shown on the Drawings or as directed by the Engineer.

(ii) Pipes shall be carefully fastened and supported within the shuttering, in order to avoid any movement when pouring concrete.

(iii) Pipes where not cast into concrete shall be adequately supported by galvanised mild steel holderbats or other approved means.

(iv) Ventitaltion pipes shall be hot finished welded steel tubes conforimg to IS: 1161.

(v) Anti corrosive paints conforming to IS 9862(Latest revision)shall be used for various steel elements

23.5.4 Steel Rungs, Ladders and Climbing Irons

(i) The steel shall conform to IS 2062 or its equivalent as shown on the drawings or as directed by Engineer.

(ii) Anti corrosion paint shall be used for various steel elements of Rungs,basket,platfiorm,ladders and climbing irons as IS :9862

(iii) Different members shall be joined with full length welds at their contacts points.

23.5.5 Abrasion resistance steel liner (in dam sluices/spillways & other works)

The contractor shall design, supply, transport, fabricate, install the steel liners in dam sluices as shown on the drawings or as approved by the Engineer. Requirements and specifications of Abrasion Resistance Steel for steel liner and stiffener shall be as under:

Sr. No	Description	Permissible values
1	Mechanical Properties	
a	Ultimate Tensile strength	1300N/mm^2
b	Minimum Yield strength	1000N/mm^2
c	Elongation	12%
2	Chemical Properties	
a)	Chemical composition (ladle analysis) in %	

(i)	Alloys Element							
	Carbon(C)	≤0.32						
	Silicon (Si)	≤ 0.70						
	Manganese (Mn)	≤ 1.80						
	Phosphorus (P)	≤0.025						
	Sulphur (S)	≤0.010						
(ii)	Micro- alloying Elements used singly or in combination for controlling hardness							
	Molybdenum(Mo)	≤0.60						
	Ni(Nickel)	≤0.80						
	Chromium(Cr)	≤ 1.50						
	Vanadium(V)	≤0.08						
	Niobium(Nb)	≤0.05						
	Boron(B)	≤0.005						
b)	Maximum Carbon equivalent							
	Thickness (inmm)	<8	8-20	(20)-32)	(32)-45	(45)-51	(51)-80	(80)-130
	CET(CEV)*	0.26 (0.41)	0.31 (0.46)	0.32 (0.52)	0.33 (0.60)	0.40 (0.59)	0.43 (0.67)	0.50 (0.76)
3	Hardness (Brinell) HBW	370-430						
4	Impact properties							
	Charpy V 10x10 mm test specimen	30 to 45 J at (-) 40°C						

$$*CET = C + \frac{(Mn+Mo)}{10} + \frac{(Cr+Cu)}{20} + \frac{Ni}{40}$$

$$*CEV = C + \frac{Mn}{6} + \frac{(Cr+Mo+V)}{5} + \frac{(Cu+Ni)}{15}$$

23.5.5.1 General

i) Steels with a high HBW rating (Brinell Hardness) shall be used for applications where wear or abrasion resistance is important.
ii) The material specification of steel liner and stiffener shall be in accordance to table-1 or equivalent or as approved by the Engineer. Profiles of the top, bottom and side curves of the opening of shall be as per drawing
iii) Based upon the approved drawings of steel liner, the contractor shall prepare fabrication and erection drawings and submit to the Engineer for approval.
iv) Material for Plugs for contact grouting shall be of the same material of steel liner.

23.5.5.2 General Specification for Fabrication and Erection of steel liner

(i) Plate Cutting Procedure

Method of plate cutting shall be as per recommendations of the plate manufacturer with the approval of the Engineer. However, out of all the known methods of cutting the following two methods shall be preferred considering the influence on the Heat Affected Zone (HAZ), the risk of cutting cracks and possible movements of the plate on the cutting table.

a) Oxy flame cutting: Oxy flame cutting can be used for cutting, preheating of the plate (75°C-100°C) is recommended to avoid cutting cracks until cutting has been completed. 2mm to 4mm of metal shall be removed from gas cut surface by machining or grinding as approved by Engineer.

b) Plasma cutting: Plasma cutting is recommended to be carried out under water to minimize environmental impact in the form of noise and air pollution.

(ii) Bending procedure

Plates for sluice section shall be formed to required shape by cold bending process only such that it does not impair the quality of steel.

a) Relationship between bending radius& plate thickness and between die opening &plate thickness recommended for achieving better results is as under.

Transverse to rolling direction	Along rolling direction minimum R/t	Die opening width transverse to rolling direction(W) W/t	Die opening width along rolling direction (W) W/t	Bending at 90° in a 'V' die
3 X th	4Xth	10 X th	12 X th	19.00

where th is thickness of plates

b) Correction of curvature neither by blows nor by hot forming shall be permitted.

(iii) Welding procedure

A. General

a) After the edges of the plates have been prepared for welding, these shall be subjected to a thorough visual examination for flaws, cracks, laminations, slag inclusion or other defects, if any, and no plates where such defects are observed, shall be used for fabrication without the approval of the Engineer.

b) The edges of plates shall be free from foreign materials such as rust, scale, paint, oil slag from the flame cutting or other contaminations of the fusion pieces.

c) The surfaces to be welded shall be free from foreign material such as grease, oil or marking paints ,irregularities ,infusion faces which are likely to affect the quality of welding shall be removed by grinding before welding is commenced.

d) Welding shall be done by a process which shall exclude the atmosphere from the molten metal viz by hand welding with shielded arc method and wherever practicable, automatic welding machines using shielded arc or submerged arc method shall be used.

e) The type of butt joint to be welded shall be either a single or double or 'V' or 'U' as shown on the drawings.

f) Where fillet welds are used the sections to be joined shall be held firmly in position while being welded.

g) All double 'V' or 'U' joints shall be welded from both the sides of joints.

h) All welding shall be in accordance with requirements of relevant standard and/or manufacturer of plates as per the approval of Engineer.

i) Weld Metal shall be deposited in successive layers and each layer shall be cleaned of all slags and other deposits before applying the next layer.

j) The reverse side shall be prepared by chipping, grinding or flat gouging so as to secure sound metal from the reverse side.

k) Temporary welds, where used to hold the sections in position shall be removed so that they shall not become a part of the permanent welded joints.

l) Wherever possible, joints shall be welded in the flat position.

m) Welded joints shall be free from craters, depressions and other irregularities/defects.

n) After the welding is completed all weld splatter shall be removed.

o) The welding of temporary attachments to the steel liner sections for the purpose of handling or aligning of sections with each other shall be limited only to those essentially required subject to the approval of the Engineer. All such attachments shall be removed by careful chipping or flame cutting and damage, if any, to the steel liner shall be repaired.

B. Welding procedure to avoid cracking

a) In determining welding procedures consideration shall be given to the avoidance of following.
   - Hydrogen induced delayed cold cracking
   - Solidification cracking.
   - Lamellar tearing.

b) In general, the following weld processes shall be used as per the approval of the Engineer.
   - Manual Metal ARC (MMA)
   - Gas Metal ARC (MIG/MAG)
   - FLUX cured ARC (FCAW)
   - Submerged ARC (SAW)
   - Tungsten inert gas welding (TIG)/ Gas tungsten arc welding (GTAW)

c) Preheat temperature of 100° C and interpass temperature of 150° C to 173° C (as recommended by the plate manufacturer) shall be required & maintained as per approval of Engineer.

d) Preheat shall be uniform and continuous.

e) Plate shall be preheat in a width of 100mm minimum (4 X thickness of plate) or more and to maintain satisfactory temperature control automatic thermostat shall be used as per the approval of the Engineer.

f) The steel plates shall not be subject to Post Weld Heat Treatment.

g) All welders assigned to manual welding shall have successfully passed the test as prescribed for welder qualification in IS,:2825 or section IX of ASME boiler pressure vessel code.

C. Welding consumables

a) Filler material having a yield strength of 900 MPA for all the welds that would be subjected to abrasion (i.e water side) shall be used, however, filler material for tack welding and root passes in these welds, which are not on water side, shall be on 500 MPa strength.

b) Filler material for all welds for stiffeners etc. At the back side of the steel liner shall have a yield strength of 500 MPa.

c)Welding consumables shall be as per American Welding Society (AWS). Filler specifications or as recommended by the steel manufacturer as per approval of Engineer.

d) Only low hydrogen welding consumables shall be used as per the approval of Engineer. Maximum hydrogen content in the weld metal shall be 5ml/100g.

e) All consumables shall be stored and handled with care and in accordance with the manufacturer's recommendations as per the approval of the Engineer.

f) Flux shall be packed in such a way that it is protected from moisture pick-up and damage, including that during transportation

(iv) Transportation

A. Dispatch and transportation

a) The transportation of the fabricated pieces and accessories from the shop to the site of erection shall be started only after obtaining approval of the Engineer.

b) The safe transport and handling of the steel liner from workshop to the site and from site store, if any to the work site shall be ensured by the contractor. He shall deploy suitable transportation and handling equipment such as trailers, Lorries, loading and unloading hoists, winches, rails, Steel rope & jacks, etc.

c) The contractor shall include and provide for saddles or supports, etc, for securely fastening and protecting the steel liner assembly in transit and at erection site so as to avoid any damage to the liner.

d) The contractor shall be fully responsible for all loss and damage caused or occasioned by any defect in handling or transportation.

e) All exposed finished surfaces shall be adequately protected against abrasion during transport.

B. Match marking and weight

a) Each part of the steel liner or other auxiliary assemblies shall be legibly marked to show their relative position with respect to adjacent parts in the finished assembly. The marking shall be made with light steel stamps.

b) A list of the weight of assemblies/components dispatched by the contractor from shop to the site of erection shall be submitted to the Engineer simultaneously.

(v) Erection

The erection of steel liner and placement of concrete shall be taken of only after the methodology and sequence of erection of steel liner submitted by the contractor has been approved by Engineer.

(vi) Inspection and testing.

a) All junction of longitudinal and transverse weld joints in steel liner shall be radiographed.

b) All butt welds in steel liner are to be 100% ultrasound tested and 25% length of welds are to the test checked by radiography as for direction of the Engineer.

c) All welds for stiffeners i.e. compound of butt and fillet/Fillet shall be subjected to Magnetic Particle Inspection (MPI) as per relevant standards. Where MPI is not possible, Dye Penetration Test as per appendix 8 of ASME code section VIII is to be carried out with Engineer approval.

d) All radiography shall be performed & supervised by the experienced personnel qualified or trained for the job from the institutes such as Bhaba Atomic Research Institute or other reputed institute of non-destructive examination.

e) Radiography shall not be taken until 24 hours after welding has been completed.

f) The contractor shall provide at his own expense all materials including radiographic films and all consumables equipment etc. necessary for radiographic examination and shall perform all radiographic examination in accordance with ASME, Boiler and Pressure Vessel Code, Section-V Article-2, and as per the requirements of the Engineer. Films duly developed shall be submitted to the Engineer within 8 working hours after taking the exposure. The films will then become the property of Employer.

g) Along with each radiograph, the contractor shall furnish his interpretation report in duplicate, in proper proforma, the Engineer shall be free to make independent interpretation and ask for the repair of welds, if necessary.

23.5.6 Earthing / Grounding system

(i) MS Flat and MS round conductor shall be of approximately 800 Sq mm crossectional area and shall conform to IS:2062, Grade A.
(ii) Lap joint of min. 100 mm length shall be maintained in all welded joints of MS Flat.
(iii) Welding joints shall be painted with two coats of Anti Corrosion Bitumen paint.
(iv) Risers to be kept / connected as per construction drawings or directions of EIC.
(v) Treatment of earthing flats to be buried in ground shall be carried out by application of bentonite slurry in 1:4 ratios of bentonite clay and water as per instruction from EIC.
(vi) Earthing shall be carried out in accordance with construction drawings or directions of EIC.
(vii) Material shall be verified by representative of EIC on its receipt at site store and shall remain in custody of contractor till its final handover after laying/installation at site.
(viii) The contractor shall have to work in close co-ordination with Hydro-Mechanical / Electro-Mechanical agencies working in the area.
(ix) All Tools and Tackles for the work shall be arranged by Contractor.

23.6 Measurement and Payments

23.6.1 Watertight Steel Covers, Frames and Gratings

Measurement for payment for the supply and installation of watertight steel covers, frames and gratings will be weight of the material installed. Payment will be made at the Unit Rate per kg entered in the BOQ.

23.6.2 Handrails and Steel Stairs

Measurement for payment for supply, handling, fabrication and installation of the haind rails steel stairs will be of the weight of steel actually installed and approved by the Engineer. Payment will be made at the Unit Rates per kg entered in the Bill of Quantities.

23.6.3 Steel Rungs and Ladders

(i) Measurement for payment for supply, handling, fabrication and installation of the Steel Rungs and Ladders will be of the weight of Steel Rungs and Ladders actually installed and approved by the Engineer. Payment will be made at the Unit Rates per MT entered in the Bill of Quantities, which shall include the entire cost of:

a) Supply, handling, fabrication, transportation to the place of installation and installation of Steel Rungs, Ladders and Climbing Irons.

b) Surveying and marking the position.

c) Testing of weld joints

(ii) For the measurement and payment purposes, the weight of the Steel Rungs and Ladders will be based on the unit weight of the steel per linear meter (without any accessories) as specified in the relevant IS codes.

23.6.4 Steel structure pipes

(i) Measurement for payment for supply, handling and installation of the steel pipes will be of the weight of steel structure pipes actually installed and approved by the Engineer. Payment will be made at the Unit Rates per MT entered in the Bill of Quantities, which shall include the entire cost of:

a) Supply, handling, fabrication, transportation to the place of installation and installation of steel structural pipes.

b) Surveying and marking the position of pipes.

c) Testing of weld joints

(ii) For the measurement and payment purposes, the weight of the steel pipes will be based on the unit weight of the steel pipes per linear meter (without any accessories) as specified in the relevant IS codes.

23.6.5 Abrasion resistance steel liner (in dam sluices/spillways & other works)

(i) Measurement for payment for supply, handling, fabrication and installation of the steel liner and stiffeners will be of the weight of steel liner actually installed and approved by the Engineer. Payment will be made at the Unit Rates per MT entered in the Bill of Quantities, which shall include the entire cost of:

a) Supply, handling, fabrication, transportation to the place of installation and installation of steel liner and stiffeners.

b) Design and fabrication drawings of steel liner and stiffeners based upon the layout drawings or as directed by the Engineer..

c) Plugs for Contact /void grouting

d) Testing of weld joints which include ultrasonic, radiographic testing and magnetic particle inspection (MPI).

e) cost of all materials, construction facilities, profession and technical services, transport, equipment, labour, assistance in testing and other necessary charges

(ii) For the measurement and payment purposes, the steel liner along with stiffeners shall be actual weighed at site or as directed by the Engineer.

23.6.6 Earthing / Grounding System

(i) Measurement for payment for Earthing / Grounding system will be of the net weight of the MS Flat and MS round conductor actually installed and approved by Engineer. For the measurement purposes, the weight of Earthing / Grounding system will be based on the unit weight of the MS Flat and MS round conductor per linear meter as specified in the relevant IS codes.

(ii) Payment will be made at the Unit Rate per MT entered in the Bill of Quantities, which shall include the entire cost of procurement, supply and installation of Earthing / Grounding system including cutting, bending, laying, tacking, welding, drilling, treatment with bentonite slurry, consumables, painting of welded joints with two layers of anti-corrosion bitumen paint, interconnection of various grids / various floors through risers and interconnecting conductors, complete in all respects.