



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II



**BHAGYANAGAR GAS LIMITED
(A JOINT VENTURE OF HPCL & GAIL)**

BID DOCUMENT FOR

**RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL)
FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S FOR 02 Years**

**UNDER OPEN DOMESTIC
COMPETITIVE BIDDING**

e- tender

Bid Document No.: BGL/636/2024-25

VOLUME-II of II



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SECTION -8
SCOPE OF WORK**



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

INDEX

- I. Mechanical Works**
- II. Electrical Works**



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

PART-I

MECHANICAL WORKS



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SCOPE OF WORK

CONTENTS

1. INTRODUCTION
2. SCOPE OF WORK (ACTIVITY-WISE)
3. DETAILED SCOPE OF WORK
4. GENERAL INSTRUCTIONS TO THE CONTRACTOR
5. REFERENCE SPECIFICATION, CODES AND STANDARDS
6. APPROVALS
7. STRUCTURES, SERVICES AND OTHER PROPERTY
8. SAFETY
9. PROGRESS OF WORK



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1. INTRODUCTION

M/s Bhagyanagar Gas Limited is planning to Construct CNG Station at Retail Outlets (On-Line / DBS / Mother Station) within GA's.

No free-issue materials are included within the scope of work for mechanical and electrical works under this tender.

2. SCOPE OF WORK.

The broad scope of work under "Mechanical Works" is essentially but not limited to the following

- I. Supply, installation, testing & commissioning of SS tube (Supplied by Contractor as a bought-out item) within trenches and testing for CNG application.
- II. Supply installation, testing & commissioning of SS (SS314) tube (within trenches) with all fixtures, fittings, isolation valves etc as required as per P&ID and testing for instrument air application.
- III. Erection of mechanical equipment (as per tentative Drawings enclosed elsewhere in the tender).
- IV. Complete work of supply bidder has to supply, installation, testing & commissioning of electrical equipment / items, ss-tubes, fittings, valves including all accessories & above ground piping work including Hydrotesting as per price schedule / Schedule of Rates (SOR) / drawings / specifications etc

2. DETAILED SCOPE OF WORK UNDER THE TENDER:

Detailed scope of work is divided under different sub-heads. List of sub-heads along with different activities (with brief specification) is evolved.

Generally the following shall constitute the Contractor's scope of work but not limited to as given herein:

SCOPE OF WORKS FOR LAYING, TESTING & COMMISSIONING OF SS TUBING:

- 3.1.1 Receiving of materials from stores (only free issue items) & Supply of SS tubes as per specification .
- 3.1.2 Laying of SS 316 tubes with SS ferrule fittings and SS ball valves (within trenches) supplied by bidder as per specification for CNG application.
- 3.1.3 Supply and Laying of SS316 tubes (within trenches) with all ferrule fittings, isolation valves and reducers (3/4", 1/2" to 1/4" OD) etc. as required as per P&ID for instrument air application. These tubes shall be painted with blue color for a bandwidth of 25 mm at every 300 mm apart to differentiate them from SS 316 main tubes (for CNG) running into the same trench.
- 3.1.4 SS tubes shall be clamped to the existing MS Angle (within trench) at every 1000mm using U-clamps (galvanized) of any approved make. It is not permitted to flatten tubes for clamping purpose.
- 3.1.5 MS Angle and U-clamps (galvanized) shall be isolated by rubber gaskets.
- 3.1.6 Carrying out pneumatic testing as per approved procedures; providing all tools, tackles,



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

instruments, manpower and other related accessories for carrying out the testing of tubes.

3.1.7 Submission of final material appropriation statements for all the materials issued by OWNER/ENGINEER-IN-CHARGE, returning surplus material to Owner stores, reconciliation of free issue material/ consumables and obtaining 'No Objection Certificate' from Owner/Engineer-in-Charge

3.2 LOADING, UNLOADING, TRANSPORTATION & ERECTION OF MECHANICAL EQUIPMENT

3.2.1 Receiving of material from stores.

3.2.2 Loading of material / equipment on a truck from stores and Safe transportation to various sites.

3.2.3 Unloading, placement and alignment on foundation—either on ground or above ground (4m) on rooftop / platform top (cascades only).

3.2.4 Making Transit Insurance of equipment from stores to site.

3.2.5 All equipment transported shall be securely boarded and transported without causing any damage to equipment. Any damage caused during loading, transportation & unloading shall be recovered from the contractor.

3.3 Deleted

3.3.1 deleted

3.3.2 Taking over the site from OWNER/ENGINEER-IN-CHARGE; carrying out pre-construction survey, making arrangement of safety, security, temporary water & electrical connections, traffic detour etc. setting out the piping GAD by laying out the plans at site.

3.3.3 Preparing QAP and taking approval from BGL including Welder's Qualification Test, Internal Test Plan, Hydrostatic Test Procedures, SS Tube & Yard Pipe testing & procedures.

3.3.4 To carry out all tests at work site, approved laboratory and place of manufacture/fabrication; provide all test certificates from manufacturers & supplier and offer inspection at all stages of procurement/construction.

3.3.5 To maintain and observe all statutory requirements with regards to labour laws, taxation laws, local statutory rules and insurance requirements.

3.3.6 To hand over clear site to OWNER/ENGINEER-IN-CHARGE after removing all debris subsequent to completed works as per scope.

3.3.7 To submit daily, weekly and monthly progress reports and to attend review meetings both at site and at project office and other discussions with Owner/ Statutory Authorities.

3.3.8 To transfer all Test Certificates, warrantees/guarantees including maintenance/performance guarantees of various fittings/fixtures, equipment/material and indemnify consultant/OWNER of any liabilities of payments/ dues to its suppliers, manufacturers, agents etc.

3.3.9 Marking all as-built details on construction/fabrication drawings/data sheets issued by OWNER/ENGINEER-IN-CHARGE and submission of as-built details and drawings in six sets.

4. General Instructions to the Contractor

4.1 Plan and prepare a schedule for execution and work implementation as per QA/QC plans to be approved by OWNER/ENGINEER-IN-CHARGE. Set out at site by carrying



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- out a pre-construction survey; establishing the site deviations, requirement of site modifications in construction drawings, earth filling /cutting requirement etc.
- 4.2 Get from OWNER/ENGINEER-IN-CHARGE the latest revision of all documents/drawings at the commencement of work/during the course of construction and execution of work at site.
- 4.3 In case any discrepancy is found between drawings & documents, the same shall be brought to the notice of the Engineer-in-charge before execution of work and decision of the Engineer-in-charge shall be final and binding to the contractor without any extra cost implication to Owner.
- 4.4 The contractor has to make all shop drawings wherever necessary, at his own cost, and get it approved by OWNER/ENGINEER-IN-CHARGE before commencement of that work at site.
- 4.5 Specification and descriptions of various items are for identification of material and works to be carried out under them. No cost shall be quoted against these unless mentioned.
- 4.6 Quantities as mentioned are indicative and can have variation from the quantities actually executed. The contractor is advised to work out the breakup of individual work items and quantities at his own before quoting any rates. OWNER is not liable for any discrepancies in the quantities and no extra time or cost shall be granted on this pretext.
- 4.7 The contractor has to obtain all types of statutory approvals including 'C' form, D' form, completion certificate, approval from electrical inspector for electrical work and DG set, electrical connection, water connection, fire department etc. and all other approvals that might be required to commission the station, from various relevant authorities during the course of work and after completion of works in co-ordination with OWNER/ENGINEER-IN-CHARGE without any cost implication to OWNER.
- 4.8 The contractor has to arrange all tools and plants, site fencing material, lighting arrangements, store, electricity and water at his own cost.
- 4.9 The contractor should quote keeping this in mind that no request for escalation in the cost shall be entertained under any circumstances by Owner after placement of order
- 4.10 The tender contain a set of key tender purpose drawings/ data. These information/details are for "Tender Purpose only". The tenderer should visit each Location and acquaint himself with site conditions of each site. No deviations and/or claims what so ever of any kind and nature would be admissible.
- 4.11 The work shall be carried out in city conditions and generally closet other roads and public services conveying a consider able volume of vehicular traffic and human activity. It is deemed necessary that the tenderer considers the "SAFETY" as the MOST IMPORTANT aspect of working conditions and is required to include in his offer all costs (direct and indirect) towards observance, compliance and provision of all safety appurtenances and norms.
- 4.12 Receiving SS tubes, fittings and other bought-out items from Contractor stores and bringing it to site, keeping proper care of, storing the same till the yard used for construction and returning the unused material to the store.
- 4.13 Installing site markers, warning signs, fencing etc. and cleaning all unserviceable materials, debris to designated disposal area and obtain a No Dues Certificate from the concerned authorities.

- 4.14 Handing over the completed works to OWNER for their operation/use purposes.
- 4.15 The Contractor has to prepare As-Built drawings, shop drawings, fabrication drawing sand submit them along-with test certificates, guarantee cards/warranty cards/service schedule any other purchase documents/literature for all equipment/fixtures/fittings installed at the time of completion of work.
- 4.16 Any other activity(ies) not mentioned/covered explicitly above, but otherwise required for satisfactory completion/operation/safety/statutory/maintenance of the works shall also be covered under the Scope of Work and has to be completed by the Contractor with in specified Schedule of Items of Works at no extra cost to OWNER.
- 4.17 The contractor has to return all the drawings issued to him from time-to-time along with the final bill to OWNER/ENGINEER-IN-CHARGE after marking As-built dimensions and details. The contractor is not permitted to make copies of any drawing/document provided to him.

5. REFERENCE SPECIFICATION, CODES AND STANDARDS

The contractor shall carry out the work in accordance with this Specification, approved construction drawings issued by OWNER, Engineer- in-charge (EIC) Standards or relevant BIS code as might be required.

Should the Contractor find any discrepancy, ambiguity or conflict in or between any of the Standards and the contract documents, then this should be promptly referred to the Engineer- in-charge (EIC) for his decision, which shall be considered binding on the contractor.

6. APPROVALS

Approval in principle for all work should be obtained from EIC prior to execution. To ensure smooth execution of the work on a day-to-day basis it will be the Contractors responsibility to liaise on with EIC/concerned engineer and obtain necessary approvals

7. STRUCTURES, SERVICES AND OTHER PROPERTY

7.1 Protection of Structures and Utilities

The Contractor shall at his own cost, support and protect all buildings, walls, fences or other structures and all utilities and property which may, unless so protected, be damaged as a result of the execution of the works. He shall also comply with the requirements in the specification relating to protective measures applicable to particular operations or kind of work.

7.2 Interference with Traffic, Street Drainage and General Public

The Work shall be executed in such a manner as to cause a minimum of inconvenience to persons requiring to use public or private roads, lanes, thorough fares, walk ways, rights of use or passages through which the works are to be executed. Closure of roads, etc. shall not be permitted without the approval of the EIC.

The contractor shall conduct his operations at all times, with a view to minimizing as far as practicable noise from construction and other objectionable nuisances (e.g. oil leakage, smoke, fumes.)



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

8. SAFETY

The Contractor shall conform to the requirements outlined in Preamble for safety requirements. In addition, the Contractor shall observe safe working practices in the storage and handling of pipes, SS tubes, flammable fluids, etc. and ensure that smoking or naked flames are not permitted in the vicinity when these works are being executed.

The Contractor shall also protect all work sites with warning signs, barricades and night lighting.

The contractor should ensure that the workers wear safety shoes and helmets while carrying out any work under the present scope.


Where the EIC determines that the Contractor is performing the working an unsafe manner, he may suspend the work until the Contractor takes corrective action. Since the work shall be carried out in city conditions and generally close to the highways/roads and public services conveying a considerable volume of vehicular traffic and human activity, it is deemed necessary that the tenderer considers the "SAFETY" as the MOST IMPORTANT aspect of working conditions and is required to include in his offer all costs (direct and indirect) towards observance, compliance and provision of all safety appurtenances and norms.

9. PROGRESS OF WORK

The Contractor shall proceed with the Work under the Contract with due expedition and without delay.

The EIC may direct in what or at what time the various stages or parts of the work under the Contract shall be performed.

If the Contractor can reasonably comply with this direction, the Contractor shall do so. If the Contractor cannot reasonably comply, the Contractor shall notify the EIC in writing giving reasons.

 <p>Bhagyanagar Gas Limited</p>	<p align="center">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p align="center">VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------

Technical specifications of SS TUBES, SS FERRULE FITTINGS, SS BALL VALVES & THERMOPLASTIC HOSES FOR CNG REFILLING STATIONS

CONTENTS

- SECTION A-1: Specifications for Supply of SS Tubes, SS Ferrule Fittings, SS Ball Valves & Thermoplastic Hoses for CNG Refilling Stations
- SECTION A-2: Specifications for SS Tube Laying and Testing.
- SECTION B: Specifications for Erection of Mechanical Equipment.
- SECTION C: Specifications for Supply, Erection & Commissioning of Miscellaneous items.
- ANNEXURE – I : List of Suppliers of Major Bought-Out Items
- SECTION D: Specifications for Supply of SS Tubes, SS Fittings & SS Valves for instrument air line.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**


VOLUME II OF
II

MECHANICAL WORKS

**SECTION A-1. SUPPLY OF SS TUBES, SS FERRULE FITTINGS, SS BALL VALVES &
THERMOPLASTIC HOSES FOR CNG REFILLING STATIONS**

CONTENTS

- 1.0 SCOPE OF SUPPLY OF SS TUBES, BALL VALVES & FERRULE FITTINGS
- 2.0 TECHNICAL SPECIFICATION FOR SS TUBES FOR CNG REFILLING STATIONS
- 3.0 TECHNICAL SPECIFICATION FOR SS FERRULE FITTINGS
- 4.0 TECHNICAL SPECIFICATION FOR SS BALL VALVES
- 5.0 TECHNICAL SPECIFICATION NO. FOR THEMOPLASTIC HOSES

 <p>Bhagyanagar Gas Limited</p>	<p style="text-align: center;">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p style="text-align: center;">VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------

1.0 Scope of supply of SS Tubes, SS Ferrule Fittings & SS Ball Valves

The contractor has to supply SS Tubes, SS Ball Valves & SS Ferrule Fittings strictly as per technical specifications detailed in the tender document for compressed natural gas(CNG) applications attached.

The SS Tubes, valves and fittings are be laid, tested and commissioned as detailed in SECTION–

B. The balance items are to be reconciled and submitted to Owner stores in good condition. The uncountable material beyond the permissible limits as specified in clause no. 6.0 of Section- B would not be paid.

The contractor is required to purchase SS Tubes, SS fittings & SS Valves as per the quantities given in Schedule of Rates (SOR) from the approved vendor list enclosed. The contractor shall take prior approval before placement of order and get the QAP approved by consultant / OWNER. The inspection of materials and / or scrutiny of documents would be carried out by OWNER/ENGINEER-IN-CHARGE / Third Party Inspection Agency.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**1.0 TECHNICAL SPECIFICATION FOR
SS TUBES FOR
CNG REFILLING STATIONS**

Contents



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Sl.No. Description

- 1.0 SCOPE OFWORK
- 2.0 CODE & STANDARD
- 3.0 PRECEDENCE
- 4.0 DEVIATION
- 5.0 SAFETY
- 6.0 SPECIFICATION
- 7.0 DOCUMENTATION
- 8.0 PACKING & SHIPMENT
- 9.0 GUARANTEE



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 SCOPE OF WORK

- 1.1 The scope of the Tenderer will include manufacture/supply, inspection/ testing/marketing/ packaging/ handling and dispatch of SS Tubes, as indicated in the Bill of Quantities meeting all the requirements as per ASTM A269.
- 1.2 All codes and standards for manufacture, testing, inspection etc. shall be of latest edition.
- 1.3 Purchaser reserves the right to delete or order additional quantities during execution of order, based on unit rates and other terms & conditions in the original order.

2.0 CODES & STANDARD

Items	Applicable Codes and Standards
Tubes	ASTM A269, ANSI B31.3

3.0 PRECEDENCE

In case of any conflict between this job specification and other document, the following order of precedence shall apply:-

- 3.1 Job Specification
- 3.2 International Standards/Codes Applicable

4.0 DEVIATION

Deviations if any required by Tenderer shall be separately furnished against each clause giving reasoning for each deviation. Tenderer to note that except the deviations furnished by them, Tenderer's offer shall be deemed to be in total conformity with the enquiry specifications.

5.0 SAFETY

- 5.1 All tubes shall be designed as per applicable code & standards.
- 5.2 All part/ component shall meet the requirement for the specified area's classification.
- 5.3 Area classification shall be Class-I, Division-I; Group-D as per NEC or Zone-I Group IIA/ IIB as per IS/ IEC Specification or equivalent specifications.

6.0 SPECIFICATION

All the items shall be suitable for compressed natural gas service and meet following specifications.

- 6.1 Tube material shall be stainless steel as per ASTM A269 (Grade TP 316).
- 6.2 Tubing material shall have minimum molybdenum content 2.5%, carbon content of max. 0.030%.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- 6.3 Tube shall be bright annealed.
- 6.4 Tube shall be seamless.
- 6.5 Tube hardness shall be less than Rb 80. Tubes shall be NACE MR 0175 certified for hardness. Hardness test shall be carried out on each tube.
- 6.6 Each tube shall be hydro-tested as per requirement of ASTM A450 clause 22.3, at a hydro-test pressure of 350 kg/cm² (g). However, it shall be ensured that the test pressure does not result in stresses exceeding the yield strength at test pressure.
- 6.7 All S.S. tubes shall be online 100% eddy current Tested as per ASTM A450.
- 6.8 Tolerance on outer diameter shall be ± 0.005 ".
- 6.9 Tube shall be of 5 to 6 meter in length.
- 6.10 Minimum thickness shall be as per following table.

Tube OD	Minimum Wall Thickness	Maximum Allowable Working Pressure psig
1"	0.120"	4700
3/4"	0.095"	4700
1/2"	0.083"	4700
3/8"	0.065"	4800
1/4"	0.035"	4800

Note: Bidder to reconfirm maximum allowable working pressure for each tube size.

- 6.11 Following documents/ certificates to be submitted.
- i) Chemical composition for heat
 - ii) Chemical composition for products
 - iii) Tensile test
 - iv) Hardness test
 - v) Flaring test
 - vi) Leak test
 - vii) Visual inspection and dimensional check
- 6.12 Tubing should be clearly marked with the specifications given in the inspection certificate with heat code, lot code, outer diameter and wall thickness with inspection certificate no.
- 6.13 Tubes should be supplied with both ends plugged.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

7.0 DOCUMENTATION


- 7.1 All documents shall be furnished in English language only.
- 7.2 At the time of bidding, bidder shall submit following documents.
- 7.3 Reference list of previous supply for similar item, giving following details.
- 7.4 Name of the customer.
- 7.5 Specification of the item i.e., size and pressure & temperature rating.
- 7.6 Service
- 7.7 Quantity
- 7.8 Year of supply
- 7.9 Copy of ISO: 9000 certification for supplier/ manufacturer.
- 7.10 Manufacturer Quality Control Plan.
- 7.11 Clause-wise deviations to the specification.
- 7.12 Following test certificates shall be furnished along-with shipment.
- 7.13 Test certificate of visual, chemical, mechanical testing (incl. tensile, hardness, flaring and leak test).
- 7.14 Manufacturers standard shop inspection & test report for all items.
- 7.15 The test report for specified tests.
- 7.16 Third party inspection report as applicable to meet the requirements of specified codes & standards as applicable.

8.0 PACKING & SHIPMENT

- 8.1 All the items shall be suitably wrapped and packaged to with stand rough handling during ocean shipment and inland journey. Tubes should be supplied with both end plugged.
- 8.2 The item shall be properly tagged and package separately to facilitate easy identification.
- 8.3 Items shall be wrapped and packaged in such-a-way that they can be preserved in original as new condition.

9.0 GUARANTEE

- 9.1 Manufacturer shall guarantee that the design, materials, manufacturing and testing of

 <p>Bhagyanagar Gas Limited</p>	<p style="text-align: center;">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p style="text-align: center;">VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------

tubes conform to the requirement of this specification. Manufacturer shall replace all tubes free of costs which fail during field pressure testing or do not perform satisfactorily due to inadequate engineering, substandard material and poor workmanship.

- 9.2 The manufacturer shall guarantee against any defect, failure or malfunctioning occurring during 12 months from the date of commissioning or 24 months from the date of supply whichever is earlier.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**2.0 TECHNICAL SPECIFICATION FOR
SS FERRULE FITTINGS FOR
CNG REFILLING STATIONS**




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Contents

Sl.No. Description

- 1.0 SCOPE OFWORK
- 2.0 CODE & STANDARD
- 3.0 PRECEDENCE
- 4.0 DEVIATION
- 5.0 SPECIFICATION
- 6.0 MARKETING, PACKING & SHIPMENT
- 7.0 DOCUMENTATION
- 8.0 GUARANTEE

 Bhagyanagar Gas Limited	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
--------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

1.0 SCOPE OF WORK

The scope of this specification covers the requirement of design, manufacture/ inspection/ testing at works/ marking/ packaging/ and supply of high-pressure SS Ferrule Fittings.

2.0 CODES & STANDARD

Items	Applicable Codes and Standards
Bar Stock	ASME SA-479-316 or DIN 4401 or BS:970-316-S31
Forging	ASME SA-182-316 or DIN 4401 or BS:970-316-S31
Thread	NPT ANSI B 1.20.1

The latest editions of the following standards are referred to in this specification.

3.0 PRECEDENCE

In case of any conflict between this job specification and other document, the following order of precedence shall apply:

- 3.1 Job Specification.
- 3.2 International Standards/ Codes Applicable.

4.0 DEVIATION

Deviations if any required by Tenderer shall be separately furnished against each clause giving reasoning for each deviation. Tenderer to note that except the deviations furnished by them, Tenderer's offer shall be deemed to be in total conformity with the enquiry specifications.

5.0 SPECIFICATION

All the items shall be suitable for compressed Natural Gas service and meet following specifications.

5.1 Materials

5.1.1 Fittings shall be manufactured from the following materials:-

- i) Bar stock shall be as per BS: 970-316-S31, DIN 4401 or ASME 479-316 but with carbon content less than 0.05% to provide increased resistance to corrosion.
- ii) Forgings shall be as per BS: 970-316-S31, DIN 4401 or ASME SA- 182-316.

5.1.2 The fittings end connections shall be compatible to tube of hardness Rb80.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

5.1.3 All component parts of the fittings shall be of the same material.

5.1.4 The ferrule material shall be able to withstand an atmosphere of Natural Gas, oil and moisture without rusting.

5.2 Design & Manufacture

5.2.1 All fittings shall be designed in conformance with the requirements of ASME B31.3 and applicable standards. Area classification applicable for all items shall be Class-1, Division-1, Group-Das per NEC or Zone-1 Group- IIA/IIB as per IS/ IEC specification or equivalent specification. All fittings shall be designed so that all parts/ components meet the requirements for the specified area classification.

5.2.2 The SS fittings shall be of flare less design and four piece construction, consisting of front and rear ferrules, nut and body suitable for use on SS tubes conforming to ASTM A269 TP316.

5.2.3 Fittings shall be rated for at least the design pressure as stipulated in the material requisition. The design of fittings shall ensure that they shall be capable of holding full tube burst pressure after only one and a quarter turn pull up of the nut.

5.2.4 The threaded ends of fittings shall be NPT as per ANSI B1.20.1.

5.2.5 The fittings shall hold the tube with collecting action producing a firm grip on the tube without substantially reducing the tube wall thickness.

5.2.6 Fittings shall not torque the tubing during original or subsequent make-up of the connection and should use geometry for inspection before and after makeup the fittings shall not require disassembly for inspection before or after makeup.

5.2.7 All tube fittings shall be gauge-able for sufficient pull up after one and a quarter turn. All tube fittings shall have a gauge-able shoulder and there will be no radius at the point where the shoulder meets the neck of the fitting body.


5.2.8 The gap inspection gauge shall be easily insert-able at finger tight position of nut. The gap inspection gauge shall not be insert-able between the nut and shoulder of the fitting after completing only one and a quarter turn pull up of the nut.

5.2.9 The tube seat counter bore in the body shall be faced flat 90° to the axis of the tubing to minimize tube expansion and subsequent galling.

5.2.10 The sealing and gripping power of the fitting shall be controlled such that the action between ferrules will overcome commercial variations in tubing wall thickness, hardness, diameter and installer skill.

5.2.11 The seal contact are as of the fittings body shall have a machined finish of 32 Ra or better.

5.2.12 The fittings body shall have no machined stop or shoulder to preclude additional

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

tightening in subsequent make-up.

5.2.13 Front Ferrule

- i) The front ferrule shall effect a long, smooth repeatable seal by contact with body and a grip hold on the tube surface.
- ii) The front ferrule shall always remain in a sprung condition to compensate for thermal stresses and to accomplish repeated make and break

Rear Ferrule

- i) The rear ferrule shall collect the tubing surface, improving the performance of the tubing in systems of high impulse or vibration.
- ii) The rear ferrule shall have a machine recess on the inside diameter and shall have complete surface hardening so as to substantially reduce the required pull up torque. Both the requirements i.e. complete surface hardness and machined recess shall be met for all rear ferrules.

5.2.15 Nuts shall have silver plated threads to act as a lubricating agent to avoid galling and to reduce tightening torque.

5.3 Inspection and Testing

5.3.1 The manufacturer shall submit typical type test reports for the following test carrier out on random samples of two ferrule fittings:-

- i) Hydraulic burst pressure test.
- ii) Helium leak test under 0.0002 PSIA negative pressure, leaks into assembly greater than 4.0×10^{-9} atm-cc/sec being unacceptable.
- iii) Gas pressure test for 25 remarks at 5000 Psig. No leakage should be detectable even after 25 remarks.
- iv) Impulse & vibration testing by "rotary beam method" for 5,00,000 impulse cycles and 20 million vibration cycles with no detectable leakage at full working pressure throughout till the end of the test.

5.4 Test Reports and Certificates

5.4.1 The manufacturer shall supply material compliance certificates conforming that the raw material for fittings conforms to the requirements of ASME Section-II and ASME Section-III sub section NB, NC and ND.

5.4.2 The manufacturer shall furnish test procedure and typical test reports of all tests conducted on fittings as per the requirements of clause 5.3.

6.0 **MARKETING, PACKING & SHIPMENT**

6.1 Heat code traceability number shall be stamped or etched on both body and nut of each fitting.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- 6.2 Replacement nuts and ferrules shall be packaged in a manner so as to allow safe and simple replacement.
- 6.3 All the items shall be suitably wrapped and packaged to with stand rough handling during ocean shipment and inland journey.
- 6.4 Item shall be properly tagged and packaged separately to facilitate easy identification.
- 6.5 Items shall be wrapped and packaged in such-a-way that they can be preserved in original as new condition.

7.0 DOCUMENTATION

- 7.1 All documents shall be furnished in English language only.
- 7.2 At the time of bidding, bidder shall submit following documents:
 - i) Reference list of previous supply for similar item, giving following details:
 - a) Name of the customer.
 - b) Specification of the item i.e., size and pressure & temperature rating.
 - c) Service
 - d) Quantity
 - e) Year of supply
 - ii) Test procedure and typical certificates to be submitted as per clause 5.3 and 5.4 of this specification.
 - iii) Manufacturer Quality Control Plan and sampling plan.
 - iv) Copy of ISO:9000 certification for supplier/ manufacturer.
- 7.3 Following test certificates shall be furnished along-with shipment.
 - i) Test certificate of chemical, mechanical testing.
 - ii) Manufacturers standard shop inspection& test report.
 - iii) The procedure and certificates to be submitted as per the requirements of clause 5.4 of this specification.

8.0 GUARANTEE

- 8.1 Manufacturer shall guarantee that the design, materials, manufacturing and testing of fittings comply with the requirement of this specification and applicable codes and standards. Manufacturer shall replace all fittings which should result defective or fail during field pressure testing or fail to perform satisfactorily due to inadequate engineering, substandard material and workmanship.
- 8.2 The manufacturer shall guarantee against any defect, failure or malfunctioning occurring during 12 months from the date of commissioning or 24 months from the date of supply whichever is earlier.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**3.0 TECHNICAL SPECIFICATION FOR
SS BALL VALVES FOR CNG REFILLING STATIONS**



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Contents

Sl.No.	Description
1.0	SCOPE OFWORK
2.0	CODE &STANDARD
3.0	PRECEDENCE
4.0	DEVIATION
5.0	MATERIALS
6.0	DESIGN & MANUFACTURE
7.0	INSPECTION &TESTING
8.0	OTHER REQUIREMENTS
9.0	TEST REPORTS & CERTIFICATES
10.0	MARKETING, PACKING & SHIPMENT
11.0	DOCUMENTATION
12.0	GUARANTEE



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 SCOPE OF WORK

- 1.1 The scope of this specification include design, manufacture/ supply, inspection/testing/ marking/packaging/handling and dispatch of SS Ball Valves as per relevant codes.
- 1.2 Purchaser reserves the right to delete or order additional quantities during execution of order, based on unit rates and other terms& conditions in the original order.

2.0 CODES & STANDARD

Items	Applicable Codes and Standards
Valves	MSS-SP-99

3.0 PRECEDENCE

- 3.1 In case of any conflict between this job specification and other document, the following order of precedence shall apply:
 - 3.1.1 Job Specification.
 - 3.1.2 International Standards/ Codes Applicable.

4.0 DEVIATION

Deviations if any required by Vendor shall be separately furnished against each clause giving reasoning for each deviation. Vendor to note that except the deviations furnished by them, Vendor's offer shall be deemed to be in total conformity with the enquiry specifications.

5.0 MATERIALS

- 5.1 The valve body shall be made out of material conforming to ASTM A479 Type 316.
- 5.2 Material of construction of ball shall conform to ASTM A276 Type 316.
- 5.3 Material of construction of seat springs shall be Alloy X-750.

6.0 DESIGN & MANUFACTURE

- 6.1 All ball valves shall be designed in conformance with the requirements of ASMEB31.3, MSS-SP-99 and other applicable code and standards. Area Classification applicable for all items shall be Class-1, Division-1, Group-D as per NEC or Zone-1 Group-IIA/ IIB as per IS/ IEC specification or equivalent specification. All fittings shall be designed so that all parts/ components meet the requirements for the specified area classification.
- 6.2 Valves shall be rated for a maximum working pressure of 5000 psig and shall be capable of operation between a temperature range of (-40)° to 250°F.
- 6.3 Valves shall have spring loaded PEEK seats allowing seal-ability over the full pressure



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

range at any port and low operating torque over the full range of pressures and temperatures.

- 6.4 Elastomeric seals, which require no packing adjustment, shall be used.
- 6.5 Valves stem shall be of bottom loaded and blow out proof design.
- 6.6 Ball shall be blow out proof and turnnion mounted.
- 6.7 Valves shall have positive wrench/ handle stops, Phenolic black wrench/ handle shall be provided. Wrench/ handle shall indicate the direction to flow. In the case of three way valves the stem shall also provide th visual indication of flow direction if the handle is removed.

7.0 INSPECTION AND TESTING

- 7.1 The valve manufacturer shall submit typical type test reports for the following test carrier out on similar valves:-
 - i) Hydrostatic seat leak test shall be carried out with de-ionized water. There shall be no detectable set leakage at 1.1 times the rated pressure of the valve.
 - ii) Gas pressure test for seat and shell shall be carried out with nitrogen at 1000 psig. There shall be no detectable external leakage. Maximum allowable seat leakage shall be 0.1 atm-cc/min.

8.0 OTHER REQUIREMENTS

- 8.1 Manufacturer should confirm that valves are approved by Rail Road Commission of Texas, LP Gas Division under regulation for compressed natural gas or ANSI/ AGA NGV 3.1 1995, CAN/ CGA-12.3-M95 "Fuel Systems Components for Natural Gas Powered Vehicles "by "Canadian Standard Association".
- 8.2 Spares and Accessories
 - i) If required, manufacturer shall furnish a list of recommended spares and accessories for valves required during start up and commissioning.
 - ii) If required, manufacturer shall furnish a list of recommended spares and accessories required for two years of manual operation and maintenance of valves.
 - iii) Manufacturer shall quote for spares and accessories as per the material requisition.

9.0 TEST REPORTS & CERTIFICATES

- 9.1 The manufacturer shall supply material compliance certificates.
- 9.2 The valve manufacturer shall provide test procedure and valve inspection and test report for type tests carried out on similar valves as per the requirements of clause 7.0.

10.0 MARKETING, PACKING & SHIPMENT



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II


- 10.1 Heat code shall be marked on valve body to facilitate tractability.
- 10.2 All the items shall be suitably wrapped and packaged to with stand rough handling during ocean shipment and inland journey.
- 10.3 Each item shall be properly tagged and packaged separately to facilitate easy identification.
- 10.4 All items shall be wrapped and packaged in such-a-way that they can be preserved in original as new condition.

11.0 DOCUMENTATION

- 11.1 All documents shall be furnished in English language only.
- 11.2 At the time of bidding, bidder shall submit following documents:
- i) Reference list of previous supply for similar item, giving following details:
 - a) Name of the customer.
 - b) Specification of the item i.e., size and pressure & temperature rating.
 - c) Service
 - d) Quantity
 - e) Year of supply
 - ii) Test procedure and typical certificates to be submitted as per clause 5.3 and 5.4 of this specification.
 - iii) Copy of ISO: 9000 certification for supplier/ manufacturer.
 - iv) Manufacturer Quality Control Plan and sampling plan.
 - v) Technical descriptive catalogue of manufacturer.
 - vi) General arrangement/ assembly drawing of valve showing all features.
 - vii) Sectional drawing showing major parts with reference number and material specification.
- 11.3 Prior to shipment, manufacturer shall submit following test certificates and documents.
- i) Test certificate of chemical, mechanical testing.
 - ii) Manufacturers standard shop inspection test.
 - iii) Manufacturers standard shop inspection and test reports.
 - iv) The procedure and certificates to be submitted as per the requirements of clause 8.0 of this specification.
 - v) Manual for installation, erection, maintenance and operating instructions including a list of recommended spares for valves.

12.0 GUARANTEE

- 12.1 Manufacturer shall guarantee that the design, materials, manufacturing and testing of

 <p>Bhagyanagar Gas Limited</p>	<p style="text-align: center;">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p style="text-align: center;">VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------

fittings comply with the requirement of this specification and applicable codes and standards. Manufacturer shall replace all fittings which should result defective or fail during field pressure testing or fail to perform satisfactorily due to inadequate engineering, substandard material and workmanship.

- 12.2 The manufacturer shall guarantee against any defect, failure or malfunctioning occurring during 12 months from the date of commissioning or 24 months from the date of supply whichever is earlier.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**4.0 TECHNICAL SPECIFICATION FOR
THERMOPLASTIC HOSES FOR
CNG REFILLING STATIONS**



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

CONTENT

Sl.No. Description

- 1.0 SCOPE OF WORK
- 2.0 CODE & STANDARD
- 3.0 PRECEDENCE
- 4.0 DEVIATION
- 5.0 SPECIFICATIONS
- 6.0 DESIGN & MANUFACTURE
- 7.0 INSPECTION AND TESTING
- 8.0 MARKETING , PACKING & SHIPMENT
- 9.0 DOCUMENTATION



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 SCOPE OF WORK

- 1.1 The scope of this specification includes design, engineering, manufacturing, inspection/ testing, marking, packaging, handling and supply/ dispatch of Conductive Core Thermoplastic Flexible Hoses as per relevant codes.
- 1.2 Purchaser reserves the right to delete or order additional quantities during execution of order, based on unit rates and other terms & conditions in the original order.

2.0 CODES & STANDARD

Sr.No.	Description
1	1/2"IDHOSE Hose Length: 3 meter with Break way coupling Hose end to end Connections:1/2"OD Tube adaptor with nut & ferrule.
1A	Break away coupling for 1/2"ID HOSE Material-SS 316 Rated Pressure- 5000 PSI @70Deg.F Min. Flowrate-2000SCFM Temperature-0Deg.F to400 Deg.F

Hose should conform to NFPA 52, AGA1-93 and ANSI / CSA NGV 4.2-2014 /CSA12.52-2014 and end connection shall conform to ASTMA276;ASTMA479,ASMESA479.

3.0 PRECEDENCE

In case of any conflict between this job specification and other document, most stringent shall apply.

4.0 DEVIATION

Deviations, if any, required by Vendor shall be separately furnished against each clause giving reasoning for each deviation. Vendor to not that except the deviations furnished by them, Vendor's offer shall be deemed to be in total conformity with the enquiry specifications.

5.0 SPECIFICATIONS

- a) The core material shall be non-metallic, flexible incomplete conformity with the relevant standard as mentioned above.
- b) Electrical conductivity shall comply with AGA1-93
- c) End connections shall be 316 stainless steel materials conforming to relevant design standard as specified above.

6.0 DESIGN & MANUFACTURE

- I. Hoses shall be designed in conformance with the requirements 52,AGA1-93 and ANSI



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

/ CSANGV 4.2-2014/CSA12.52-2014 and other applicable code and standards. Area classification applicable for all items shall be Class-1, Division-1, Group-D as per NEC or Zone-1 Group- HA/ HB as per IS/IEC specification or equivalent specification. All fittings shall be designed so that all parts/components meet the requirements for the specified area classification.

- II. End connections shall be designed in conformance with the requirement of ASTM A276;ASTMA479,ASMESA479.
- III. The whole assembly shall be rated for a working pressure of 5000 psi and shall be rated for temperature range of(-40)°to250°F.

7.0 **INSPECTION AND TESTING**

The manufacturer shall submit typical type test reports for the following test carried out:

- I. Hydrostatic test shall be carried out with de-ionized water. There shall be no detectable leakage at 1.5 times the rated pressure.
- II. Electrical conductivity test shall be carried out.
- III. Mechanical properties as a result of the test conducted and
- IV. Chemical analysis report

7.1 **TEST REPORTS & CERTIFICATES**

- I. The manufacturer shall supply material compliance certificates.
- II. Chemical Analysis report
- III. Mechanical properties test report
- IV. Hydrostatic test report
- V. Electrical conductivity test report
- VI. Warranty certificate

8.0 **MARKETING, PACKING & SHIPMENT**

- 8.1 Heat code shall be marked to facilitate tractability.
- 8.2 All the items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
- 8.3 Each item shall be properly tagged and package separately to facilitate easy identification.
- 8.4 All items shall be wrapped and packaged in such-a-way that they can be preserved in original as new condition.
- 8.5 Packing note shall carry easily identifiable name or code of the physical item

9.0 **DOCUMENTATION**

- 9.1 All documents shall be furnished in English language only.
- 9.2 At the time of bidding, bidder shall submit following documents:
 - I. Reference list of previous supply for similar item, giving following details:
 - a) Name of the customer.
 - b) Specification of the item i.e., size and pressure & temperature rating.
 - c) Service
 - d) Quantity
 - e) Year of supply



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- II. Test procedure and typical certificates to be submitted as per clause 5.3, 5.4 and 5.5 of this specification.
 - III. Copy of regulatory compliance document/certification for similar product supplied earlier.
 - IV. Manufacturer Quality Control Plan and sampling plan.
 - V. Technical descriptive catalogue of manufacturer.
 - VI. General arrangement/ assembly drawing showing all features.
 - VII. Sectional drawing showing major parts with reference number and material specification.
- 1.1 Prior to shipment, manufacturer shall submit one set of all the documents and test certificates as specified above. And one set of the same documents and certificates along with the material in addition to the following documents:
- i. Manual for installation, erection, maintenance and operating instructions including a list of recommended spares.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SECTION- A-2: SS TUBE LAYING, TESTING AND COMMISSIONING




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

CONTENTS

- 1.0 SCOPE OF WORK AND TECHNICAL SPECIFICATION
- 2.0 INSTALLATION PROCEDURE
- 3.0 REMAKE OF FITTINGS
- 4.0 REFERENCE SPECIFICATION, CODES AND STANDARDS
- 5.0 SCOPE OF SUPPLY
- 6.0 SCRAP AND EXCESS MATERIAL

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

1.0 **SCOPE OF WORK AND TECHNICAL SPECIFICATION**

1.1 **LAYING OF SS TUBE**

Laying, testing and commissioning of SS tubes and fittings complete with all supports. The MS Angle and U-clamps (galvanized) / other fixing arrangement shall be procured and installed by the contractor. Payment shall be at the rate for the work set out in the agreed Schedule of Rates.

Contractor shall engage OWNER approved sub-contractor for this specialized work. The list of parties are enclosed in Annexure-I.

1.2 **SCOPE OF WORKS: FOR LAYING, TESTING & COMMISSIONING OF SSTUBING**

Generally, the following shall constitute the Contractor's scope of work but not limited to as given herein:

- 1.2.1 SS tubes shall be clamped to the MS Angle at every 1000 mm using U-clamps (galvanized) OR P-clamps of SWAGELOK make / any other approved make / SS- 308 clamps with EPDM cushion. The practice of flattening tubes for clamping purposes shall not be permitted.
- 1.2.2 MS Angle and U-clamps (galvanized) shall be procured from approved manufacturers and through a QAP including stage inspection and pre-dispatch inspection of the materials by OWNER. . (To be isolated by rubber gaskets).
- 1.2.3 Tubes shall be bend using tube benders only and any hot bending will be totally rejected. Tubes shall be cut using pipe cutting device. Hot cutting is not allowed.
- 1.2.4 Carrying out pneumatic testing and purging with nitrogen as per approved procedures; providing all tools, tackles, instruments, manpower and other related accessories for carrying out the testing of tubes.
- 1.2.5 Start-up and commissioning assistance.
- 1.2.6 Handing over the completed works to OWNER for their operation/ use purposes.
- 1.2.7 Any other work not specifically mentioned herein but required for the satisfactory completion/ operation/ safety/ statutory/ maintenance of the works shall also be covered under the scope of work and has to be completed by the Contractor within specified schedule at no extra cost to OWNER.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

2.0 INSTALLATION PROCEDURE

2.1 TUBE END PREPARATION

- 2.1.1 Cut the ends square with a hacksaw and a suitable guide. Tube cutters are satisfactory for most tube materials but tend to work harden stainless steel. As such proper care shall be exercised while cutting the SS tubes to avoid the hardening.
- 2.1.2 Burrs must be removed inside and outside for proper entry into fitting to prevent contamination and/ or restricted flow. 'Swagelok' / 'Parker' deburring tool shall be used.
- 2.1.3 Remove all fittings, chips, and grit before attachment of fittings.

2.2 ASSEMBLY

- 2.2.1 Tube line fabrication must be accurate so that the tube end easily enters the fitting in proper alignment. Do not force an improperly fitted tube line into the fittings.
- 2.2.2 Ensure that the tube end is bottomed against the shoulder in the fitting body. This is necessary to prevent movement of the tube while the nut forces the ferrule to grip the tube and to seal through any imperfections that may exist on the outside tube surface.
- 2.2.3 Never permit the fitting body to rotate during tube end make-up, use two wrenches. Assemble port connectors to components first and hold with a wrench while making up the tube joint. All types of union bodies must be held while each of the tube ends is made up.
- 2.2.4 Never attempt to make up by torque.
- 2.2.5 Always turn the nut the prescribed amount regardless of torque required. Fitting end plugs required only 1- ¼ turn from finger tight make up in all sizes.

3.0 REMAKE OF FITTINGS

A disassembled joint can be remade, simply by retightening the nut to the position of the original make up. For maximum number of remakes, mark the fitting and nut before disassembly. Before retightening, make sure the assembly has been inserted into the fitting until the ferrule(s) seats in the fitting. Retighten the nut by hand. Rotate the nut with a wrench to the original position as indicated by the previous marks lining up. (A noticeable increase in mechanical resistance will be felt indicating the ferrule is being re-sprung into sealing position.) Then snug the nut 1/12 turn (1/2 hex flat) past the original position.

4.0 REFERENCE SPECIFICATION, CODES AND STANDARDS

The Contractor shall carry out the work in accordance with this specification, PMC's Engineering Standards, ASME B 31.8 - Gas Transmission and Distribution Piping Systems, Oil Industry Safety Directorate (OISD) norms.

Should the Contractor find any discrepancy, ambiguity or conflict in or between any of the Standards and the contract documents, then this should be promptly referred to the Engineer-in-Charge (EIC) for his decision, which shall be considered binding on the contractor.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

5.0 SCOPE OF SUPPLY

5.1 SUPPLIED BY THE CONTRACTOR AT HIS OWN COST AS PART OF THIS SPECIFICATION:

The procurement and supply of MS Angle with U- clamps at the appropriate time of all the materials and consumables except for the materials specifically enlisted under Owner's scope of supply, shall be entirely the Contractor's responsibility and its rates of execution shall be inclusive for all these items, as follows but not limited to these:

- i) Bolts and nuts for supports, U-bolts with nuts, P-clamps for tubes, anchor bolts of various sizes for fixing to concrete structure.
- ii) Bitumen paints primer and solvents.
- iii) All material for minor civil works like grouting etc.,
- iv) Minor structural steel for fabrication of tube/ tray supports like MS plates, GI plates, flats, pipe etc.,
- v) Pumps, compressor, Corrosion Inhibitor for water used for hydrostatic testing, including water for testing, inert gas for purging.
- vi) All items not expressly mentioned in the Contract but which are necessary for the satisfactory completion and performance of the Work under this Contract.

Note: Samples of all the consumables items / test certificates required to be approved by EIC.

6.0 SCRAP AND EXCESS MATERIAL

Every month the Contractor shall submit an account for all the materials issued to him by the owner in the standard Performa prescribed for this purpose by the Engineer-in-charge.

On completion of the work, the Contractor shall submit material appropriation statements for all the materials issued by the Owner in the standard perform. The following scrap allowances are permissible.

ITEM	UNACCOUNTABLE	SCRAP
Tube	1 %	1% (Less than 0.3 m)
Valves	0 %	0%
Ferrule Fittings	0 %	0 %

All excess materials and scrap shall be returned after duly accounting for, to the OWNER stores. Where materials are to be weighed before return, the Contractor shall be responsible for making necessary arrangements for weighing etc. The contractor shall not use scrap sections obtained during the course of construction for fabrication of temporary supports or other items without prior written permission of Engineer-in-Charge.

If the Contractor fails to return the surplus material aforesaid, the Owner will charge the Contractor for such unreturned material at penal rates, which will be deducted from whatever amount is due to the Contractor. In case any material issued by the Owner deteriorates during storage by the Contractor, new material will be issued to him if available at penal rates, but delay in procuring such materials will be at the Contractor's account only. Any damaged valve and ferrule fittings should not be used.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SECTION -B: ERECTION OF MECHANICAL EQUIPMENT




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

CONTENTS:

1. SCOPE OF WORK FOR LOADING, UNLOADING, TRANSPORTATION & ERECTION OF EQUIPMENT.
2. EQUIPMENT WEIGHTS & SIZES.

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

LOADING, UNLOADING, TRANSPORTATION & ERECTION OF MECHANICAL EQUIPMENT

1.0 SCOPE OF WORK:

1.1 Generally the following shall constitute the Contractor's scope of work but not limited to as given herein:

- i) Receiving of material from stores.
- ii) Loading of material/ equipment on a trailer / truck from stores. Safe transportation to various sites.
- iii) Unloading, placement and alignment on foundation -on ground or aboveground + 4.5 m at roof top (cascade only).
- iv) Transit Insurance of equipment from stores to site.
- v) All equipment transported shall be securely boarded and transported without causing any damage to equipment. Any damage caused during loading, transportation & unloading shall be recoverable from the contractor
- vi) All the equipment shall be leak tested after erection as per instruction of engineer in charge and standard practice.

2.0 Equipment weight & sizes

SI No.	Equipment	Size (approx.)	Weight/Unit Approx
1.	Cascade 4500 L / 3000L(water liter capacity)	5.3 M X 1.7 M X 1.6 M (H)/ 4 M X 1.75 M X 1.6 M (H) Approx	9.0 T/ 6.0T

All excess, unutilized or defective materials and scrap shall be returned after duly accounting for, to the OWNER. stores. Where materials are to be weighed before return, the Contractor shall be responsible for making necessary arrangements for weighing etc. The contractor shall not use scrapped or defective materials obtained during the course of construction for fabrication of temporary supports or other items without prior written permission of Engineer-in-Charge.

If the Contractor fails to return the surplus material aforesaid, the Owner will charge the Contractor for such un-returned material at penal rates, which will be deducted from whatever amount is due to the Contractor. In case any material issued by the Owner deteriorates during storage by the Contractor, new material will be issued to him if available at penal rates, but delay in procuring such materials will be at the Contractor's account only.

Contractor to arrange all equipment & tools such as cranes, winch, lifting hook etc and skilled & semiskilled manpower and consumables for erection of all the electro-mechanical equipment.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SECTION – C: SUPPLY, ERECTION & COMMISSIONING OF MISCELLANEOUS ITEMS

CONTENTS:

1. FIRE FIGHTING EQUIPMENT




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SUPPLY, ERECTION & COMMISSIONING OF MISCELLANEOUS ITEMS

- 1.0 Fire Fighting Equipment:- Contractor will supply and erect at designated locations the firefighting equipment. The details of the firefighting equipment are given below. **(if applicable)**
1. Supply and installation of 4.5 kg capacity CO2 type fire extinguishers with steel cylinder with discharge valve and conforming to IS: 2878-1975. Extinguisher shall be painted with red enamel paint and hardware/ bracket required for fixing to wall.
 2. Supply and installation of 10 kg capacity dry chemical powder (DCP) type fire extinguisher with extinguishers cabinet suitable for inverted operation and fabricated from MS sheet internally protected with anticorrosive treatment and hydraulically tested. Extinguishers shall be externally painted with red enamel paint. Manufacturing code IS: 13849.
 3. Supply and installation of 75 kg capacity trolley mounted dry chemical powder (DCP) type fire extinguisher suitable for inverted operation fabricated from MS sheet internally protected with anticorrosive treatment and hydraulically tested extinguishers externally painted with red enamel. Manufacturing code IS: 10658.
 4. Providing & installation of galvanized mild steel fire buckets of 9 ltrs. capacity made as per IS: 2546 including supplying & fixing of MS angle iron stand to accommodate 6 nos. of fire buckets and first fill with sand/water all complete as per direction of Engineer In charge (One set consisting of 6 buckets with stand).

Note: The equipment are to be purchased from the vendor list enclosed.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

**STANDARD TECHNICAL SPECIFICATION OF HEALTH, SAFETY AND ENVIRONMENT
(HSE) MANAGEMENT**

C O N T E N T S

SL. NO.	DESCRIPTION
1.0	SCOPE
2.0	REFERENCES
3.0	REQUIREMENT OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLETED BY BIDDERS.
4.0	DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR
5.0	RECORDS

ANNEXURE-A
ANNEXURE-B
ANNEXURE-C
ANNEXURE-D
ANNEXURE-E

1.0 SCOPE

This specification establishes the Healthy, Safety and Environment (HSE) management requirement to be compiled with by the Contractors during construction. This specification is not intended to replace the necessary professional judgement needed to design & implement an effective HSE system for construction activities and the contractor is expected to exceed requirements given in this specification. Requirement stipulated in this specification shall supplement the requirement of HSE management given in relevant Act (S)/ legislations. General Condition of Contract (GCC) Special Condition of Contract (SCC) and Job Specifications. Where different documents stipulate different requirements, the most stringent shall be adopted.

2.0 REFERENCES

This document should be read in conjunction with following:

- General Conditions of Contract (GCC)
- Special Conditions of Contract (SCC)
- Building and other construction workers (regulation of employment and condition of service) Act, 1996
- Job Specifications
- Relevant IS Codes (refer Annexure-A)
- Reporting Formats (refer Annexure-B)
- Statutory requirements

3.0 REQUIREMENT OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLETED BY BIDDERS.

3.1 Management Responsibility

3.1.1 The Contract should have a document HSE policy to cover commitment of the organization to ensure health, safety and environment aspects in their line of operations

3.1.2 The HSE management system of the Contractor shall cover HSE requirement including but not limited to what specified under clause 1.0 & 2.0 mentioned above

3.1.3 Contractor shall be fully responsible for planning and implementing HSE requirement to the satisfaction of the company. Contractor as a minimum requirement shall designate/deploy the following to co-ordinate the above:


No. Of workers deployed

Up to 250

- Designate one safety supervisor who will guide the workers from time to time, as well as impart training basic guidelines at least weekly once.

Above 250 & upto 500

- Deploy one qualified and experienced safety Engineer/ Officer who will guide the workers from time to time as well as impart basic guideline & training at least weekly once. He / She shall possess a recognized Degree in any branch of engineering or technology or architecture and had a post qualification construction experience of minimum two years or possess a recognized Diploma in any branch of engineering or

 Bhagyanagar Gas Limited	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
--------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

technology or Graduate in Science stream and had a post qualification construction experience of minimum five years.

Above 500 - One additional safety engineer/Officer
 (for every 500 or less) whose function will be as mentioned above

Contractor shall indemnify and hold harmless OWNER/ PMC & their representative's from any and all liabilities arising out of non fulfillment of HSE requirements.

Above is the minimum requirement and the Contractor shall ensure physical presence of a safety personnel at each place where Hot work permit is required. No work shall be started at site until above safety personnel are physically present at site. The contractor shall submit a safety organogram clearly indicating the lines of responsibility and reporting system. He shall furnish Bio-Data/Resume/Curriculum Vitae of the safety personnel he intends to mobilize, at least 1 month before the intended mobilization, for PMC/Owner's approval.

3.1.4 The Contractor shall ensure that the Health, Safety and Environment (HSE) requirements are clearly understood & faithfully implemented at all levels, at each and every site/ work place.


3.1.5 The Contractor shall promote and develop consciousness for Health, Safety and Environment among all personnel working for the Contractor. Regular awareness programs and fabrication shop/work site meeting shall be arranged on HSE activities to cover hazards involved in various operations during construction.

3.1.6 Arrange suitable first aid measures such as First Aid Box, trained personnel to give First Aid, Stand by Ambulance or Vehicle and install fire protection measures such as: adequate number of steel buckets with sand and water and adequate fire extinguishers to the satisfaction of OWNER/ PMC. In case the number of workers exceeds 500, the Contractor shall position an ambulance /vehicle on full time basis very close to the worksite.

3.1.7 The Contractor shall evolve a comprehensive planned and documented system for implementation and monitoring of the HSE requirements. This shall submitted to OWNER & PMC for approval well in advance, prior to start of work. The monitoring for implementation shall be done by regular inspection and compliance to the observations thereof. The Contractor shall get similar HSE requirements implemented at his sub-contractor (s) work site/ Office. However, compliance of HSE requirement shall be the sole responsibility of the Contractor. Any review/ approval by OWNER/ PMC shall not absolve the Contractor of his responsibility/ liability in relation to all HSE requirements.

3.1.8 Non-Conformance on HSE by the Contractor (including his Sub-contractors) as brought out during review/ audit by PMC/ OWNER representative shall be resolved forthwith by Contractor. Compliance report shall be possibility submitted to PMC/ OWNER at the earliest.

3.1.9 The Contractor shall ensure participation of his Resident Engineer/Site-in-Charge in

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

the Safety Committee/HSE Committee meetings arranged by OWNER/ PMC. The compliance of any observation shall be arranged urgently. Contractor shall assist OWNER/ PMC to achieve the targets set by them on HSE during the project implementation.

The contractor shall ensure that his staff members & workers (permanent as well casual) shall not be in a state of intoxication during working hours and shall abide by any law relating to consumption & possession of intoxicating drinks or drugs in force. Awareness about local laws on this issue shall form part of the Induction Training.

The contractor shall ensure that all personnel working for him comply with No-smoking requirements of the owner as notified from time to time. Cigarettes, lighters, auto ignition tools or appliances shall not be allowed inside the plant complex. Smoking shall be permitted only inside smoking booths expressly designated & authorized by the Owner/ PMC.

3.1.10 The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliance or continuous failure in implementation of any of HSE provisions; OWNER/ PMC may impose stoppage of work without any Cost & Time implication to Owner and/or impose a suitable penalty for non-compliance with a notice of suitable period, upto a cumulative limit of 1.0% (one percent) of Contract value with a ceiling of Rs. 10 lakhs.

0.2% (Zero decimal two percent) of the contract value for LSTK, EPC, EPCC or Package contracts with an overall ceiling of Rs. 1,00,00,000/- (Rupees one crore).

This penalty shall be in addition to all other penalties specified else where in the contract. The decision of imposing stoppage of work, its extent & monetary penalty shall rest with PMC/OWNER & binding on the Contractor.

3.1.11 All fatal accidents and other personnel accidents shall be investigated by a team of Contractor's senior personnel for root cause and recommend corrective and preventive actions. Findings shall document and suitable actions taken to avoid recurrences shall be communicated to OWNER / PMC. OWNER / PMC shall have the liberty to independently investigate such occurrences and Contractor shall extend all necessary help and co-operation in this regard. PMC / Owner shall have to right to share the content of this report with the outside world.

3.2 House Keeping

3.2.1 Contractor shall ensure that a high degree of house keeping is maintained and shall ensure the followings:

- a. All surplus earth and debris are removed/disposed off from the working site to identified location (s).
- b. Unused/Surplus Cables Steel items and steel scrap lying scattered at different places within the working areas are removed to identified location (s).
- c. All wooden scrap, empty wooden cable drums and other combustible packing materials shall be removed from work place to identified location(s).
- d. Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete chips and bricks, etc. shall not be allowed in the roads to obstructs free movement of men & machineries.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- e. Fabricated steel structural' s, pipes & piping materials shall be stacked properly for erection.
- f. Water logging on rods shall not be allowed.
- g. No parking of trucks/ trolleys, cranes and trailers etc. shall be allowed on of roads, which may obstruct the traffic movements.
- h. Utmost care shall be taken to ensure over all cleanliness and proper up keep of the working areas.
- i. Trucks carrying sand, earth and pulverized materials etc. shall be covered while moving within the plant areas.
- j. The contractor shall ensure that the atmosphere in plant area and on roads is free from particulate matter like dust, sand, etc. by keeping the top surface wet for ease in breathing.
- k. At least two exits for any unit area shall be assured at all times.

3.3 Healthy, Safety and Environment

- a) The Contractor shall provide safe means of access to any working place including provision of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen, and OWNER/ PMC. Contractor shall ensure deployment of appropriate equipment and appliances for adequate safety and healthy of the workmen and protection of surrounding areas.


Contractor shall ensure identification of all Occupational Health, Safety & Environmental hazards in the type of work he is going to undertake and enlist mitigation measures. Contractor shall carry out Job Safety Analysis (JSA) specifically for high risk jobs like working at height & in confined space, deep excavations, radiography jobs, electrical installations, blasting operations, demolishing / dismantling activities, welding / gas cutting jobs and submit the findings to PMC / Owner. The necessary HSE measures devised shall be in place prior to start of an activity by the contractor.

- b) The Contractor shall ensure that all their staff workers including their sub- Contractor (s) shall wear Safety Helmet and Safety shoes. Contractor shall also ensure use of safety belt, protective goggles, gloves etc. by the personnel as per jobs requirements. All these gadgets shall conform to relevant IS specification equivalent.

The Contractor shall ensure that all their staff, workers and visitors including their sub-contractor(s) have been issued (records to be kept) & wear appropriate PPEs like nape strap type safety helmets preferably with head & sweat band with ¾" cotton chin strap (made of industrial HDPE), safety shoes with steel toe cap and antiskid sole, full body harness (C₁ marked and conforming to EN361), protective goggles, gloves, ear muffs, respiratory protective devices, etc. All these gadgets shall conform to applicable IS Specifications / C₁ or other applicable international standards.

Owner may issue a comprehensive color scheme for helmets to be used by various agencies. The Contractor shall follow the scheme issued by the owner. All Safety / Fire personnel shall preferably wear red colour helmet so that workmen can approach them for guidance during emergencies.

For shot blasting, the usage of protective face shield and helmets, gauntlet and protective clothing is mandatory.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

For offshore jobs/contracts, contractor shall provide PPEs (new) to PMC & Owner's personnel, at his (contractor's) cost. All personnel shall wear life jacket at all time. An indicative list of HSE standards/codes is given under Appendix-A.

The contractor shall issue height permit for working at height after verifying and certifying the checkpoints as specified in the attached permit (Format No. HSE-6). He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence to personal protective equipments.

The permit shall be issued initially for one week or expected duration of an activity and extended further for the balance duration. This permit shall be applicable in areas where specific clearance from Owner's operation Deptt. / Safety Deptt. is not required. PMC field Engineers / Safety Officers / Area Coordinators may verify and counter sign this permit (as an evidence of verification) during the execution of the job.

In case work is undertaken without taking sufficient precautions as given in the permit, PMC Engineers may cancel the permit and stop the work till satisfactory compliance is arranged. Contractors are expected to maintain a register for issuance of permit and extensions thereof including preserving the used permits for verification during audits etc.

Contractor shall arrange (at his cost) and ensure use of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing / descending tall structures. These arresters should lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the user at any point of rope. In order to avoid shock, the system should be capable of keeping the person in vertical position in case of a fall.

Contractor shall ensure that Full body harnesses conforming EN361 and having authorized CC marking is used by all personnel while working at height. The lanyards and life lines should have enough tensile strength to take the load of the worker in case of a fall. One end of the lanyard shall be firmly tied with the harnesses and the other end with life line. The harness should be capable of keeping the workman vertical in case of a fall, enabling him to rescue himself.

Contractor shall provide Roof Top Walk Ladders for carrying out activities on sloping roofs in order to reduce the chances of slippages and falls.

- c) Contractor shall ensure that a proper Safety Net System shall be used at appropriate locations. The safety net shall be located not more than 30 feet (9.0 metres) below the working surface at site to arrest or to reduce the consequences of possible fall of persons working at different heights.
- d) Contractor shall ensure that flash back arrestors conforming to BS:6158 or equivalent are installed on all gas cylinders as well as at the torch end of the gas hose, while in use. All cylinders shall be mounted on trolleys and provided with a closing key. The burner and the hose placed downstream of pressure reducer shall be equipped with Flash Back Arrester / Non Return Valve device. The hoses for acetylene and oxygen cylinders must be of different colours. Their connections to cylinders and burners shall be made with a safety collar. At end of work, the cylinders in use shall be closed and

hoses depressurized. All welding machines shall have effective earthing. In order to help maintain good housekeeping, and to reduce fire hazard, live electrode bits shall be contained safely and shall not be thrown directly on the ground.

- e) The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health for driving of vehicles, handling and erections of materials and equipment's. All lifting equipments shall be tested certified for its capacity before use. Adequate and suitable lighting at every work place and approach there to shall be provided by the contractor before starting the actual work/ operation at night.

Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overloading risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations. The contractor shall be responsible for safe operations of different equipments mobilized and used by him at the workplace like transport vehicles, engines, cranes, mobile ladders, scaffoldings, work tools, etc.

- f) Hazardous and/or toxic material such as solvent coating or thinners shall be stored in appropriate containers.
- g) All hazardous materials shall be labeled with the name of the materials, the hazards associated with its use and necessary precautions to be taken.

The work place shall be checked prior to start of activities to identify the location, type and condition of any asbestos materials which could be disturbed during the work. In case asbestos material is detected, usage of appropriate PPEs by all personnel shall be ensured and the matter shall be reported immediately to PMC / Owner.

- h) Contractor shall ensure that during the performance of the work all hazards to the health of personnel have been identified assessed and eliminated.
- i) Chemical spills shall be contained & cleaned up immediately to prevent further contamination.
- j) All personnel exposed to physical agents such as ionizing or non-ionizing radiation ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with type of exposure involved. For ionizing radiation, requirements of Bhabha Atomic Research Centre (BARC)/ Atomic Energy Regulatory Board (AERB) shall be followed.
- k) Where contract or exposure of hazardous materials could exceed limits or could otherwise have harmful affects, appropriate personal protective equipment's such as gloves, goggles, aprons, chemical resistant clothing and respirator shall be used.
- l) Contractor shall ensure the following facilities at work sites:
- l) A Crèche where 10 or more female workers are having children below the age of 6 years.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- II) Reasonable Canteen facilities are made available at appropriate location depending upon site conditions.
- m) Suitable facilities for toilet, drinking water, proper lighting shall be provided at site and labor camps, commensurate with applicable Laws/Legislation.
- n) Contractor shall ensure storage and utilization methodology of material that are not detrimental to the environment. Wherever required Contractor shall ensure that only the environment friendly material are selected.
Emphasize on recycling of waste materials such as metals, plastics, glass, paper, oil & solvents. The waste that can not be minimized, reused or recovered shall be stored and disposed of safely. In no way, toxic spills shall be allowed to percolate into the ground. The contractor shall not use the empty areas for dumping the wastes.
- o) All person deployed at site shall be knowledgeable of and comply with the environmental laws, rules & regulation relating to the hazardous materials substance and wastes. Contractor shall not dump, release or otherwise discharge or dispose off any such materials without the authorization of OWNER/ PMC.
Suitable scaffoldings shall be provided to workmen for all works that cannot be safely done from the ground or from solid construction except such short period work that can be safely done using ladders. When a ladder is used, an extra workman shall be engaged for holding the ladder.

The contractor shall ensure that the scaffolds used during construction activities shall be strong enough to take the designed load. Owner / PMC reserves the right to ask the contractor to submit certification and or design calculations from his Engineering regarding load carrying capacity of the scaffoldings.

All scaffoldings shall be inspected by a Scaffolding Inspector of the contractor. He shall paste a GREEN tag on each scaffold found safe and a RED tag on each scaffold found unsafe. Scaffoldings with GREEN tag only shall be permitted to be used and RED ones shall immediately be removed from the site.

All electrical installations / connections shall be carried out as per the provisions of latest revision of following codes/standards, in addition to the requirements of Statutory Authorities and IE / applicable international rules & regulations:

- OISO SID 173 : Fire prevention & protection system for electrical installations
- SP 30 (BIS) : National Electric Code

All electrical installations shall be approved by the concerned statutory authorities.

- The contractor shall meet the following requirements:
 - i) Ensure that electrical systems and equipment including tools & tackles used during construction phase are properly selected, installed, used and maintained as per provisions of the latest revision of the Indian Electrical / applicable international regulations.
 - ii) Shall deploy qualified & licensed electricians for proper & safe installation and for regular inspection of construction power distribution system / points including their earthing. A copy of the license shall be submitted to PMC / Owner for records. Availability of at least one competent licensed electrician shall be ensured at site round the clock to attend to the normal / emergency jobs.

- iii) All switchboards / welding machines shall be kept in well-ventilated & covered shed. The shed shall be elevated to avoid water logging. No flammable materials shall be used for constructing the shed. Also flammable materials shall not be stored in and around electrical equipment / switchboard. Adequate clearances and operational space shall be provided around the equipment.
- iv) Fire extinguishers and insulating mats shall be provided in all power distribution centers.
- v) Temporary electrical equipment shall not be employed in hazardous area without obtaining safety permit.
- vi) Proper house keeping shall be done around the electrical installations.
- vii) All temporary installations shall be tested before energising, to ensure proper earthing, bonding, suitability of protection system, adequacy of feeders/cables etc.
- viii) All welders shall use hand gloves irrespective of holder voltage.
- ix) Multilingual (Hindi, English and local language) caution boards, shock treatment charts and instruction plate containing location of isolation point for incoming supply, name & telephone No. of contact person in emergency shall be provided in substations and near all distribution boards / local panels.
- x) Operation of earth leakage device shall be checked regularly by temporarily connecting series test lamp (2 bulbs of equal rating connected in series) between phase and earth.
- xi) Regular inspection of all installations (at least once in a month)
- The following features shall also be ensured for all electrical installations during construction phase by the contractor:
 - i) Each installation shall have a main switch with a protective device, installed in an enclosure adjacent to the metering point. The operating height of the main switch shall not exceed 1.5 M. The main switch shall be connected to the point of supply by means of armoured cable.
 - ii) The outgoing feeders shall be double or triple pole switches with fuses / MCBs. Loads in a three phase circuit shall be balanced as far as possible and load on neutral should not exceed 20% of load in the phase.
 - iii) The installation shall be adequately protected against overload, short circuit and earth leakage by the use of suitable protective devices. Fuses wherever used shall be HRC type. Use of rewirable fuses shall be strictly prohibited. The earth leakage device shall have an operating current not exceeding 30 mA.
 - iv) All connections to the hand tools / welding receptacles shall be taken through proper switches, sockets and plugs.
 - v) All single phase sockets shall be minimum 3 pin type only. All unused sockets shall be provided with socket caps.
 - vi) Only 3 core (P+N+E) overall sheathed flexible cables with minimum conductor size of 1.5 mm² copper shall be used for all single phase hand tools.
 - vii) Only metallic distribution boxes with double earthing shall be used at site. No wooden

- boxes shall be used.
- viii) All power cables shall be terminated with compression type cable glands. Tinned copper lugs shall be used for multistrand wires / cables.
 - ix) Cables shall be free from any insulation damage.
 - x) Minimum depth of cable trench shall be 750 mm for MV & control cables and 900 mm for HV cables. These cables shall be laid over a sand layer and covered with sand, brick & soil for ensuring mechanical protection. Cables shall not be laid in waterlogged area as far as practicable. Cable route markers shall be provided at every 25 M of buried trench route. When laid above ground, cables shall be properly cleated or supported on rigid poles of atleast 2 M high. Minimum head clearance of 6 meters shall be provided at road crossings.
 - xi) Under ground road crossings for cables shall be avoided to the extent feasible. In any case no under ground power cable shall be allowed to cross the roads without pipe sleeve.
 - xii) All cable joints shall be done with proper jointing kit. No taped / temporary joints shall be used.
 - xiii) An independent earthing facility should preferably be established within the temporary installation premises. All appliances and equipment shall be adequately earthed. In case of armoured cables, the armour shall be bonded to the earthing system.
 - xiv) All cables and wire rope used for earth connections shall be terminated through tinned copper lugs.
 - xv) In case of local earthing, earth electrodes shall be buried near the supply point and earth continuity wire shall be connected to local earth plate for further distribution to various appliances. All insulated wires for earth connection shall have insulation of green colour.
 - xvi) Separate core shall be provided for neutral. Earth / Structures shall not be used as a neutral in any case.
 - xvii) ON/OFF position of all switches shall be clearly designated / painted for easy isolation in emergency.

The contractor shall identify all operations that can adversely affect the health of its workers and issue & implement mitigation measures.

For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.

To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.


Appropriate respiratory protective devices shall be used to protect workmen from inhalation of air borne contaminants like silica, asbestos, gases, fumes, etc.

Workmen shall be made aware of correct methods for lifting, carrying, pushing & pulling of heavy loads. Wherever possible, manual handling shall be replaced by mechanical lifting equipments.

For jobs like drilling / demolishing / dismantling where noise pollution exceeds the specified limit of 85 decibels, ear muffs shall be provided to the workers.

To avoid upper limb disorders and backaches, Display Screen Equipments' workplace stations shall be carefully designed & used with proper sitting postures. Power driven hand-held tools shall be maintained in good working condition to minimize their vibrating effects and personnel using these tools shall be taught how to operate them safely & how to maintain good circulation in hands.

The contractor shall arrange health check up for all the workers at the time of induction. Health check may have to be repeated if the nature of duty assigned to him is changed necessitating health check or doubt arises about his wellness. PMC / Owner reserve the right to ask the contractor to submit test reports.

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Weather Protection:

Contractor shall take appropriate measures to protect workers from severe storms, solar radiations, poisonous gases, dust, etc. by ensuring proper usage of PPEs like Sun glasses, Sun screen lotions, respirators, dust masks, etc. and rearranging / planning the construction activities to suit the weather conditions.

Communication

All persons deployed at the work site shall have access to effective means of communication so that any untoward incident can be reported immediately and assistance sought by them.

All health & safety information shall be communicated in a simple & clear language easily understood by the local workforce.

Unsuitable Land Conditions

Contractor shall take appropriate measures and necessary work permits / clearances if work is to be done in or around marshy areas, river crossings, mountains, monuments, etc.

Under Water Inspection

Contractor shall ensure that boats and other means used for transportation, surveying & investigation works shall be certified seaworthy by a recognized classification society. It shall be equipped with all life saving devices like life jackets, adequate fire protection arrangements and shall possess communication facilities like cellular phones, wireless, walkie-talkie. All divers used for seabed surveys, underwater inspections shall have required authorized license, suitable life saving kit. Number of hours of work by divers shall be limited as per regulations. PMC / Owner shall have the right to inspect the boat and scrutinize documents in this regard.

TOOL BOX MEETING (TBM)

Contractor shall conduct daily TBM with workers prior to start of work and shall maintain proper record of the meeting. A suggested format is given below. The TBM is to be conducted by the immediate supervisor of the workers.

TOOLBOX MEETING RECORDING SHEET

Date & Time		
Subject		
Presenter		
Hazards involved		
Precautions to be taken		
Worker's Name	Signature	Section
Remarks, if any		

The topics during TBM shall include

- Hazards related to work assigned on that day and precautions to be taken.
- Any forthcoming HSE hazards / events / instruction / orders, etc.

The above record can be kept in local language, which workers can read. These records shall be made available to PMC / Owner whenever demanded.

TRAINING

Contractor shall ensure that all his personnel possess appropriate training to carry out the assigned job safely. The training should be imparted in a language understood by them and should specifically be trained about

- Potential hazards to which they may be exposed at their workplace
- Measures available for prevention and elimination of these hazards The topics during training shall cover, at the minimum;
- Education about hazards and precautions required
- Emergency and evacuation plan
- HSE requirements
- Fire fighting and First-Aid
- Use of PPEs
- Local laws on intoxicating drinks, drugs, smoking in force

Records of the training shall be kept and submitted to PMC / Owner whenever demanded.

For offshore and jetty jobs, contractor shall ensure that all personnel deployed have undergone a structured sea survival training including use of lifeboats, basket landing, use of radio communication etc. from an agency acceptable to Owner / PMC.

INSPECTION

The contractor shall carryout daily HSE inspection and record observations at a central location. These inspection records shall be freely accessible to Owner / PMC representatives. The contractor shall also assist Owner / PMC representatives during the HSE inspections conducted by them.

ADDITIONAL SAFETY REQUIREMENTS FOR WORKING INSIDE A RUNNING PLANT

As a minimum, the contractor shall ensure adherence to following safety requirements while working in or in the close vicinity of an operating plant :

- a) Contractor shall obtain permits for Hot work, Cold work, Excavation and Confined Space from Owner in the prescribed format.
- b) The contractor shall monitor, record and compile list of his workers entering the operational plant/unit each day and ensure & record their return after completing the job.
- c) Contractor's workers and staff members shall use designated entrances and proceed



Bhagyanagar Gas
Limited


**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- by designated routes to work areas only assigned to them. The workers shall not be allowed to enter units' area, tanks area, pump rooms, etc. without work authorization permit.
- d) Work activities shall be planned in such a way so as to minimize the disruption of other activities being carried out in an operational plant / unit and activities of other contractors.
 - e) The contractor shall submit a list of all chemicals / toxic substances that are intended to be used at site and shall take prior approval of the Owner.
 - f) Specific training on working in a hydrocarbon plant shall be imparted to the work force and mock drills shall be carried out for Rescue operations / First-Aid measures.
 - g) Proper barricading / cordoning of the operational units / plants shall be done before starting the construction activities. No unauthorized person shall be allowed to trespass. The height and overall design of the barricading structure shall be finalized in consultation with the Owner and shall be got approved from the Owner.
 - h) Care shall be taken to prevent hitting underground facilities such as electrical cables, hydrocarbon piping during execution of work.
 - i) Barricading with water curtain shall be arranged in specific/critical areas where hydrocarbon vapors are likely to be present such as near horton spheres or tanks. Positioning of fire tenders (from owner) shall also be ensured during execution of critical activities.
 - j) Emergency evacuation plan shall be worked out and all workmen shall be apprised about evacuation routes. Mock drill operations may also be conducted.
 - k) Flammable gas test shall be conducted prior to any hot work using appropriate measuring instruments. Sewers, drains, vents or any other gas escaping points shall be covered with flame retardant tarpaulin.
 - l) Respiratory devices shall be kept handy while working in confined zones where there is a danger of inhalation of poisonous gases. Constant monitoring of presence of Gas / Hydrocarbon shall be done.
 - m) Clearance shall be obtained from all parties before starting hot tapping, patchwork on live lines and work on corroded tank roof.
 - n) Positive isolation of line/equipment by blinding for welding/cutting/grinding shall be done. Closing of valve will not be considered sufficient for isolation.
 - o) Welding spatters shall be contained properly and in no case shall be allowed to fall on the ground containing oil. Similar care shall be taken during cutting operations.
 - p) The vehicles, cranes, engines, etc. shall be fitted with spark arresters on the exhaust pipe and got it approved from Safety Department of the Owner.
 - q) Plant air should not be used to clean any part of the body or clothing or use to blow off dirt on the floor.
 - r) Gas detectors should be installed in gas leakage prone areas as per requirement of Owner's plant operation personnel.
 - s) An experienced full time safety personnel shall be exclusively deployed to monitor safety aspects in running plants.

HSE PROMOTION

The contractor shall encourage his workforce to promote HSE efforts at workplace by way of organizing workshops / seminars / training programmes, celebrating HSE awareness weeks & National Safety Day, conducting quizzes & essay competitions, distributing pamphlets, posters & material on HSE, providing incentives for maintaining good HSE practices and granting bonus for completing the job without any lost time accident.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
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4.0 **DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR**

4.1 **On Award of Contract**

The Contractor shall prior to start of work submit his Health, Safety and Environment Manual of procedure and HSE Plans for approval by OWNER/ PMC. The Contractor shall participate in the pre-start meeting with OWNER/ PMC to finalize HSE plans including the following.

- Job procedure to be followed by Contractor for activities covering Handling of equipment's, Scaffolding, Electric Installation, describing the risks involved, actions to be taken and methodology for monitoring each.
- Organizations structure alongwith responsibility and authority records/ reports etc. on HSE activities.

4.2 **During job execution**

4.2.1 Implement approved Health, Safety and Environment management procedure including but not limited to as brought our under para 3.0. Contractor shall also ensure to:

- Arrange workmen compensation insurance, registration under ESI Act, third party liability insurance etc. as applicable.
- Arrange all HSE permits before start of activities (as applicable) like her work, confined space, work at heights, storage of Chemicals/explosives materials and its use and implement all precautions mentioned therein
- Submit timely the completed check list on HSE activities, Monthly HSE report, accident report, investigation report, etc. as per OWNER/ PMC requirements. Compliance of instructions on HSE shall be done by Contractor and informed urgently to OWNER/ PMC.
- Ensure that resident Engineers/Site-In-Charge of the Contractor shall amend all the Safety Committee/HSE meeting arranged by OWNER/ PMC only in case of his absence from site, a seconds senior most person shall be nominated by him in advance and communicated to OWNER/ PMC.
- Display at site office and work locations caution boards, list of hospitals for emergency services available.
- Provided posters, banners, for safe working to promote safety consciousness
- Carryout audits/inspection at sub Contractor work as per approved HSE documents & submit the reports for OWNER/ PMC review.
- Assist in HSE audits by OWNER/ PMC and submit compliance report.
- Generate & submit HSE records/ reports as per HSE Plan.
- Appraise OWNER/ PMC on HSE activities at site.

5.0 **RECORDS**

At the minimum, the contractor shall maintain/ submit HSE records in the following reporting formats:

- | | | |
|----|--------------------------------------------------------|-------|
| 1. | Monthly HSE Checklist cum compliance report | HSE-1 |
| 2. | Accident / Incident Report | HSE-2 |
| 3. | Supplementary Accident / Incident Investigation report | HSE-3 |



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

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|----|--------------------------------------|-------|
| 4. | Near Miss Incident Report | HSE-4 |
| 5. | Monthly HSE Report | HSE-5 |
| 6. | Permit for working at height | HSE-6 |
| 7. | Permit for working in confined space | HSE-7 |
| 8. | Permit for radiation work | HSE-8 |
| 9. | Permit for demolishing / dismantling | HSE-9 |



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

ANNEXURE-A

A. I.S. CODES ON HSE

SP:53	Safety code for the use, Care and protection of hand operated tools.
IS: 818	Code of practice for safety and health requirements in electric and gas welding and cutting operations
IS: 1179	Eye and Face precautions during welding, equipment etc.
IS: 1860	Safety requirements for use, care and protection of abrasive grinding wheels.
IS: 1989 (Part-I & II)	Leather safety boots and shoes
IS: 2925	Industrial Safety Helmets
IS: 3016	Code of practice for fire safety precautions in welding and cutting operations.
IS: 3043	Code of practice for earthing.
IS: 3764	Code of safety for excavation work
IS: 3786	Methods for computation of frequency and severity rates for industrial injuries and classification of industrial accidents.
IS: 3996	Safety Code of scaffolds and ladders.
IS: 4082	Recommendation on stacking and storage of construction materials and components at site.
IS: 4770	Rubber gloves for electrical purposes
IS: 5121	Safety code for piling and other deep foundations
IS: 5216 (Part-I)	Recommendations on Safety procedures and practices in electrical works
IS: 5557	Industrial and Safety rubber lined boots.
IS: 5983	Eye protectors
IS:6519	Selection, care and repair of Safety footwear
IS: 6994 (Part-I)	Industrial Safety Gloves (Leather & Cotton Gloves)
IS: 7293	Safety Code for working with construction Machinery



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- IS: 8519 Guide for selection of industrial safety equipment for body protection
- IS: 9167 Ear protectors
- IS: 11006 Flash back arrestor (Flame arrestor)
- IS:11016 General and safety requirements for machine tools and their operation I
- S: 11057 Specification for Industrial safety nets
- IS: 11226 Leather safety footwear having direct moulded rubber sole
- IS: 11972 Code of practice for safety precaution to be taken when entering a sewerage system
- IS: 13367 Code of practice-safe use of cranes
- IS: 13416 Recommendations for preventive measures against hazards at working place

B. INTERNATIONAL STANDARDS ON HSE

- Safety Glasses : ANSI Z 87.1, ANSI ZZ 87.1, AS 1337, BS 2092, BS 1542, BS 679, DIN 4646 / 58211
- Safety Shoes : ANSI Z 41.1, AS 2210, EN 345
- Hand Gloves : BS 1651
- Ear Muffs : BS 6344, ANSI S 31.9
- Hard Hat : ANSI Z 89.1 / 89.2, AS 1808, BS 5240, DIN 4840
- Goggles : ANSI Z 87.1
- Face Shield : ANSI Z 89.1
- Breathing Apparatus : BS 4667, NIOSH
- Welding & Cutting : ANSI Z 49.1
- Safe handling of : P-1 (Compressed Gas Association
compressed Gases : 1235 Jefferson Davis Highway, Arlington VA 22202 – USA) in
cylinders

ANNEXURE-B

DETAILS OF FIRST AID BOX

1.	Small size Roller Bandages, 1 inch wide (Finger Dressing small)	6 Pcs.
2.	Medium size Roller Bandages, 2 inch wide (Hand and Foot Dressing)	6 Pcs.
3.	Large size Roller Bandages, 4 inch wide (Body Dressing Large)	6 Pcs.
4.	Large size Burn Dressing (Burn Dressing Large)	4 Pkts.
5.	Cotton wool (20 gms packing)	4 Pkts.
6.	Antiseptic Solution Dettol (100 ml.) or Savlon	1 Bottle
7.	Mercurochrome Solution (100 ml.) 2% in water	1 Bottle
8.	Ammonia Solution (20 ml.)	1 Bottle
9.	A Pair of Scissors	1 Piece
10.	Adhesive Plaster (1.25 cm x 5 m)	1 Spool
11.	Eye pads in Separate Sealed Packet	4 Pcs.
12.	Tourniquet	1 No.
13.	Safety Pins	1 Dozen
14.	Tinc. Iodine / Betadin (100 ml.)	1 Bottles
15.	Ointment for burns (Burnol 20 gms.)	1 Bottole
16.	Polythene Wash cup for washing eyes	1 No.
17.	Potassium Permanganate (20 gms.)	1 Pkt.
18.	Tinc. Benzoine (100 ml.)	1 Bottole
19.	Triangular Bandages	2 Nos.
20.	Band Aid Dressing	5 Pcs.
21.	Iodex / Moov (25 gms.)	1 Bottole
22.	Tongue Depressor	1 No.
23.	Boric Acid Powder (20 gms.)	2 Pkt.
24.	Sodium Bicarbonate (20 gms.)	1 Pkt.
25.	Dressing Powder (Nebasulf) (10 gms.)	1 Bottole
26.	Medicinal Glass	1 No.
27.	Duster	1 No.
28.	Booklet (English & Local Language)	1 No. each
29.	Soap	1 No.
30.	Toothache Solution	1 No.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

31.	Eye Ointment	1 Bottle
32.	Vicks (22 gms.)	1 Bottle
33.	Forceps	1 No.
34.	Cotton Buds (5 nos.)	1 Pkt.
35.	Note Book	1 No.
36.	Splints	4 Nos.
37.	Lock	1 Piece
38.	Life Saving/Emergency/Over-the Counter Drugs	As decided at site

Note : The medicines prescribed above are only indicative. Equivalent medicines can also be used.

A prescription, in this regard, shall be required from a qualified Physician.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

ANNEXURE – C

TYPE OF FIRES VIS-À-VIS FIRE EXTINGUISHERS

Fire	Fire Extinguishers				
	Water	Foam	CO ₂	Dry Powder	Multi Purpose (ABC)
Originated from paper, clothes, wood	<input type="checkbox"/>	<input type="checkbox"/>	Can control minor surface fires	Can control minor surface fires	<input type="checkbox"/>
Inflammable liquids like alcohol, diesel, petrol, edible oils, bitumen	x	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Originated from gases like LPG, CNG, H ₂	x	x	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electrical Fires	x	x	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Legend : Can be used x Not to be used

Note : Fire extinguishing equipment must be checked atleast once a year and after every use by an authorized person. The equipment must have an inspection label on which the next inspection date is given. Type of extinguisher shall clearly be marked on it.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

ANNEXURE – D

Indicative List of Statutory Acts & Rules Relating to HSE

- The Indian Explosives Act and Rules
- The Motor Vehicle Act and Central Motor Vehicle Rules
- The Factories Act and concerned Factory Rules
- The Petroleum Act and Petroleum Rules
- The Workmen Compensation Act
- The Gas Cylinder Rules and the Static & Mobile Pressure Vessels Rules.
- The Indian Electricity Act and Rules
- The Indian Boiler Act and Regulations
- The Water (Prevention & Control & Pollution) Act
- The Water (Prevention & Control of Pollution) Cess Act
- The Mines & Minerals (Regulation & Development) Act
- The Air (Prevention & Control of Pollution) Act
- The Atomic Energy Act
- The Radiation Protection Rules
- The Indian Fisheries Act
- The Indian Forest Act
- The Wild Life (Protection) Act
- The Environment (Protection) Act and Rules
- The Hazardous Wastes (Management & Handling) Rules
- The Manufacturing, Storage & import of Hazardous Chemicals Rules
- The Public Liability Act
- The Building and Other Construction Workers (Regulation of Employment and Condition of service) Act
- Other statutory acts Like EPF, ESIS, Minimum Wage Act.

**ANNEXURE – E
CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES**

<i>ACTIVITY</i>	<i>TYPE OF HAZARD</i>	<i>EFFECT OF HAZARD</i>	<i>PREVENTIVE MEASURES</i>
(A) EXCAVATION Pit Excavation up to 3.0m	➤ Falling into pit	➤ Personal injury	<ul style="list-style-type: none"> ➤ Provide guard rails/barricade with warning signal. ➤ Provide at least two entries/exits. ➤ Provide escape ladders.
	➤ Earth Collapse	<ul style="list-style-type: none"> ➤ Suffocation / Breathlessness ➤ Buried 	<ul style="list-style-type: none"> ➤ Provide suitable size of shoring and strutting, if required. ➤ Keep soil heaps away from the edge equivalent to 1.5m or depth of pit whichever is more. ➤ Don't allow vehicles to operate too close to excavated areas. Maintain at least 2m distance from edge of cut. ➤ Maintain sufficient angle of repose. Provide slope not less than 1:1 and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock. ➤ Battering/benching the sides.
	<ul style="list-style-type: none"> ➤ Contact with buried electric cables ➤ Gas/ Oil Pipelines 	<ul style="list-style-type: none"> ➤ Electrocutation ➤ Explosion 	<ul style="list-style-type: none"> ➤ Obtain permission from competent authorities, prior to excavation, if required. ➤ Locate the position of buried utilities by referring to plant drawings. ➤ Start digging manually to locate the exact position of buried utilities and thereafter use mechanical means.
Pit Excavation beyond 3.0m	➤ Same as above plus	➤ Can cause drowning	➤ Prevent ingress of water

<i>ACTIVITY</i>	<i>TYPE OF HAZARD</i>	<i>EFFECT OF HAZARD</i>	<i>PREVENTIVE MEASURES</i>
	➤ Flooding due to excessive rain/ underground water	situation	➤ Provide ring buoys ➤ Identify and provide suitable size dewatering pump or well point system
	➤ Digging in the vicinity of existing Building/ Structure	➤ Building/ Structure may collapse ➤ Loss of health & wealth	➤ Obtain prior approval of excavation method from local authorities ➤ Use under-pining method ➤ Construct retaining wall side by side
	➤ Movement of vehicles / equipments close to the edge of cut.	➤ May cause cave-in or slides ➤ Persons may get buried	➤ Barricade the excavated area with proper lighting arrangements ➤ Maintain at least 2m distance from edge of cut and use stop block to prevent over-run. ➤ Strengthen shoring and strutting
Narrow deep excavations for pipelines, etc.	➤ Same as above plus ➤ Frequent cave-in or slides	➤ May cause severe injuries or prove fatal	➤ Battering/benching of sides ➤ Provide escape ladders
	➤ Flooding due to Hydrostatic testing	➤ May arise drowning situation	➤ Same as above plus ➤ Bail out accumulated water ➤ Maintain adequate ventilation
Rock excavation by blasting	➤ Improper handling of explosives	➤ May prove fatal	➤ Ensure proper storage, handling & carrying of explosives by trained personnel. ➤ Comply with the applicable explosive acts & rules.
	➤ Uncontrolled explosion	➤ May cause severe injuries or prove fatal	➤ Allow only authorized persons to perform blasting operations. ➤ Smoking and open flames are to be strictly prohibited.

	➤ Scattering of stone pieces in atmosphere	➤ Can hurt people	➤ Use PPE like goggles, face mask, helmets etc.
Rock excavating	➤ Entrapping of	➤ May cause	➤ Barricade the area
ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
by blasting (Contd)	persons/ animals.	severe injuries or prove fatal	with red flags and blow siren before blasting.
	➤ Misfire	➤ May explode suddenly	➤ Do not return to site for at least 20 minutes or unless announced safe by designated person.
Piling Work	➤ Failure of pile-driving equipment	➤ Can hurt people	➤ Inspect Piling rigs and pulley blocks before the beginning of each shift.
	➤ Noise pollution	➤ Can cause deafness and psychological imbalance	➤ Use personal protective equipments like ear plugs, muffs, etc.
	➤ Extruding rods / casing	➤ Can hurt people	➤ Barricade the area and install sign boards ➤ Provide first-aid
	➤ Working in the vicinity of 'Live-Electricity'	➤ Can cause electrocution / asphyxiation	➤ Keep sufficient distance from Live-Electricity as per IS code. ➤ Shut off the supply, if possible ➤ Provide artificial/rescue breathing to be injured.
(B) CONCRETING	➤ Air pollution by cement	➤ May affect Respiratory System	➤ Wear respirators or cover mouth and nose with wet cloth.
	➤ Handling of ingredients	➤ Hands may get injured	➤ Use gloves and other PPE.
	➤ Protruding reinforcement rods.	➤ Feet may get injured	➤ Use Safety shoes. ➤ Provide platform above reinforcement for movement of workers.
	➤ Earthing of electrical mixers, vibrators, etc. not done	➤ Can cause electrocution / asphyxiation	➤ Ensure earthing of equipments and proper functioning of electrical circuit before commencement of

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

			work.
	➤ Falling of materials from height	➤ Persons may get injured	➤ Use hard hats ➤ Remove surplus material immediately from work place
			➤ Ensure lighting arrangements during night hours.
	➤ Continuous pouring by same gang	➤ Cause tiredness of workers and may lead to accident.	➤ Insist on shift pattern ➤ Provide adequate rest to workers between subsequent pours.
	➤ Revolving or concrete mixer/ vibrators	➤ Parts of body or clothes may get entrapped.	➤ Allow only mixers with hopper ➤ Provide safety cages around moving motors ➤ Ensure proper mechanical locking of vibrator
Super-structure	➤ Same as above plus ➤ Deflection in props or shuttering material	➤ Shuttering / props may collapse and prove fatal	➤ Avoid excessive stacking on shuttering material ➤ Check the design and strength of shuttering material before commencement of work ➤ Rectify immediately the deflection noted during concreting
	➤ Passage to work place	➤ Improperly tied and designed props / planks may collapse	➤ Ensure the stability and strength of passage before commencement of work ➤ Do not overload and under the passage.
(C) REINFORCEMENT	➤ Curtailment and binding of rods	➤ Persons may get injured	➤ Use PPE like gloves, shoes, helmets, etc. ➤ Avoid usage of shift tools
	➤ Carrying of rods for short distance/ at heights	➤ Workers may injure their hands and	➤ Provide suitable pads on shoulders and use safety gloves. ➤ Tie up rods in easily

		shoulders	<ul style="list-style-type: none"> ➤ liftable bundles ➤ Ensure proper staging.
	<ul style="list-style-type: none"> ➤ Checking of clear distance/ cover with hands 	<ul style="list-style-type: none"> ➤ Rods may cut or injure the finger 	<ul style="list-style-type: none"> ➤ Use measuring devices tape, measuring rods, etc.
	<ul style="list-style-type: none"> ➤ Hitting projected rods and standing on cantilever 	<ul style="list-style-type: none"> ➤ Persons may get injured and fall down 	<ul style="list-style-type: none"> ➤ Use safety shoes and avoid standing unnecessarily on cantilever rods
	rods		<ul style="list-style-type: none"> ➤ Avoid wearing loose clothes
	<ul style="list-style-type: none"> ➤ Falling of material from height 	<ul style="list-style-type: none"> ➤ May prove fatal 	<ul style="list-style-type: none"> ➤ Use helmets ➤ Provide safety nets
	<ul style="list-style-type: none"> ➤ Transportation of rods by trucks / trailers 	<ul style="list-style-type: none"> ➤ Protruded rods may hit the persons 	<ul style="list-style-type: none"> ➤ Use red flags/lights at the ends ➤ Do not protrude the rods in front of or by the side of driver's cabin. ➤ Do not extend the rods 1/3rd of deck length or 1.5 m which is less
(D) WELDING AND GAS CUTTING	<ul style="list-style-type: none"> ➤ Welding radiates invisible ultraviolet and infrared rays 	<ul style="list-style-type: none"> ➤ Radiation can damage eyes and skin. 	<ul style="list-style-type: none"> ➤ Use specified shielding devices and other PPE of correct specifications ➤ Avoid throated tungsten electrodes for GTAW.
	<ul style="list-style-type: none"> ➤ Improper placement of oxygen and acetylene cylinders 	<ul style="list-style-type: none"> ➤ Explosion may occur 	<ul style="list-style-type: none"> ➤ Move out any leaking cylinder ➤ Keep cylinder in vertical position ➤ Use trolley for transportation of cylinders and chain them ➤ Use flash back arrestors
	<ul style="list-style-type: none"> ➤ Leakage / cuts in hoses 	<ul style="list-style-type: none"> ➤ May cause fire 	<ul style="list-style-type: none"> ➤ Purge regulators immediately and then turn off ➤ Never use grease or oil on oxygen line connections and copper fittings on acetylene lines

			<ul style="list-style-type: none"> ➤ Inspect regularly gas carrying hoses ➤ Always use red hose for acetylene & other fuel gases and black for oxygen.
	➤ Opening-up of cylinder	➤ Cylinder may burst	➤ Always stand back from the regulator while opening the cylinder
			<ul style="list-style-type: none"> ➤ Turn valve slowly to avoid bursting ➤ Cover the lug terminals to prevent short circuiting.
	Welding of tanks, container or pipes storing flammable liquids	Explosion may occur	<ul style="list-style-type: none"> ➤ Empty & purge them before welding ➤ Never attach the ground cable to tanks, container or pipe storing flammable liquids ➤ Never use LPG for gas cutting
(E) RADIOGRAPHY	Ionizing Radiation	Radiations may react with the skin and can cause cancer, skin irritation, dermatitis, etc.	<ul style="list-style-type: none"> ➤ Ensure safety regulations as per BARC/AERB before commencement of job. ➤ Cordon off the area and install Radiation warning symbols ➤ Restrict the entry of unauthorized persons ➤ Wear appropriate PPE and film badges issued by BARC/AERB
	Transportation and Storage of Radiography source	Same as above	<ul style="list-style-type: none"> ➤ Never touch or handle radiography source with hands ➤ Store radiography source inside a pit in an exclusive isolated storage room with lock and key arrangement. The pit should be approved by BARC/AERB

			<ul style="list-style-type: none"> ➤ Radiography source should never be carried either in passenger bus or in a passenger compartment of trains. ➤ BARC/AERB have to be informed before source movement. Permission from Director General of Civil Aviation is required for booking radio isotopes with airlines.
	Loss of Radio isotope	Same as above	<ul style="list-style-type: none"> ➤ Try to locate with the help of Survey Meter. ➤ Inform BARC/AERB(*) <p>(*) Atomic Energy Regulatory Board (AERB), Bhabha Atomic Research Centre (BARC) Anushaktinagar, Mumbai – 400 094</p>
ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(F) ELECTRICAL INSTALLATION AND USAGE	Short circuiting	Can cause Electrocutio n or Fire	<ul style="list-style-type: none"> ➤ Use rubberized hand gloves and other PPE ➤ Don't lay wires under carpets, mats or door ways. ➤ Allow only licensed electricians to perform on electrical facilities ➤ Use one socket for one appliance ➤ Ensure usage of only fully insulated wires or cables ➤ Don't place bare wire ends in a socket ➤ Ensure earthing of machineries and equipments ➤ Do not use damaged

			<ul style="list-style-type: none"> ➤ cords and avoid temporary connections ➤ Use spark-proof/flame proof type field distribution boxes. ➤ Do not allow open/bare connections ➤ Provide all connections through ELCB ➤ Protect electrical cables / equipment's from water and naked flames ➤ Check all connections before energizing.
	Overloading of Electrical System	Bursting of system can occur which leads to fire	<ul style="list-style-type: none"> ➤ Display voltage and current ratings prominently with 'Danger' signs. ➤ Ensure approved cable size, voltage grade and type. ➤ Switch off the electrical utilities when not in use. ➤ Do not allow unauthorized connections. ➤ Ensure proper grid wise distribution of Power.
	Improper laying of overhead and underground transmission lines / cables	Can cause electrocution and prove fatal	<ul style="list-style-type: none"> ➤ Do not lay unarmored cable directly on ground, wall, roof of trees ➤ Maintain at least 3m distance from HT cables ➤ All temporary cables should be laid at least 750 mm below ground on 100 mm fine sand overlying by brick soling ➤ Provide proper sleeves at crossings/ intersections ➤ Provide cable route



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

<i>ACTIVITY</i>	<i>TYPE OF HAZARD</i>	<i>EFFECT OF HAZARD</i>	<i>PREVENTIVE MEASURES</i>
(G) FIRE PREVENTION AND PROTECTION	Small fires can become big ones and may spread to the surrounding areas	Cause burn injuries and may prove fatal.	<ul style="list-style-type: none"> ➤ markers indicating the type and depth of cables at intervals not exceeding 30m and at the diversions / termination. ➤ In case a fire breaks out, press fire alarm system and shout "Fire, Fire" ➤ Keep buckets full of sand & water/fire extinguishing equipment near hazardous locations ➤ Confine smoking to 'Smoking Zones' only ➤ Train people for using specific type of fire equipments under different classes of fire
			<ul style="list-style-type: none"> ➤ Keep fire doors/ shutters, passages and exit doors unobstructed ➤ Maintain good house keeping and first-aid boxes (for detail refer Annex-2) ➤ Don't obstruct access to Fire extinguishers ➤ Do not use elevators for evacuation during fire ➤ Maintain lightening arrestors for elevated structures ➤ Stop all electrical motors with internal combustion. ➤ Move the vehicles from dangerous locations.

			➤ Remove the load hanging from the crane booms. Remain out of the danger areas.
	Improper selection of Fire Extinguisher	It may not extinguish the fire	➤ Ensure usage of correct fire extinguisher meant for the specified fire (for details refer Appendix- C) Do not attempt to extinguish Oil and electric fires with water. Use foam cylinders/CO ₂ /sand or earth.
	Improper storage of highly inflammable substances	Same as above	➤ Maintain safe distance of flammable substances from source of ignition ➤ Restrict the distribution of flammable materials to only min. necessary amount Construct specifically designed fuel storage facilities
			➤ Keep chemicals in cool and dry place away from heat. Ensure adequate ventilation ➤ Before welding operation, remove or shield the flammable material properly ➤ Store flammable materials in stable racks, correctly labeled preferably with catchments trays. Wipe off the spills immediately
	Short circuiting of electrical system	➤ Same as above Can cause Electrocutio n	➤ Don't lay wires under carpets, mats or door ways ➤ Use one socket for one appliance

<i>ACTIVITY</i>	<i>TYPE OF HAZARD</i>	<i>EFFECT OF HAZARD</i>	<i>PREVENTIVE MEASURES</i>
			<ul style="list-style-type: none"> ➤ Use only fully insulated wires or cables ➤ Do not allow open/bare connections ➤ Provide all connections through ELCB ➤ Ensure earthing of machineries and equipments
(H) VEHICULAR MOVEMENT	Crossing the Speed Limits (Rash driving)	Personal injury	<ul style="list-style-type: none"> ➤ Obey speed limits and traffic rules strictly ➤ Always expect the unexpected and be a defensive drive ➤ Use sat belts/helmets ➤ Blow horn at intersections and during overtaking operations. ➤ Maintain the vehicle in good condition ➤ Do not overtake on curves, bridges and slopes
	Adverse weather condition	Same as above	<ul style="list-style-type: none"> ➤ Read the road ahead and ride to the left ➤ Keep the wind screen and lights clean ➤ Do not turn at speed ➤ Recognize the hazard, understand the defense and act correctly in time.
	Consuming alcohol before and during he driving operation	Same as above	<ul style="list-style-type: none"> ➤ Alcohol and driving do not mix well. Either choose alcohol or driving. ➤ If you have a choice between hitting a fixed object or an oncoming vehicle, hit the fixed object ➤ Quit the steering at once and become a passenger. Otherwise

			<ul style="list-style-type: none"> ➤ take sufficient rest and then drive. ➤ Do not force the driver to drive fast and round the clock ➤ Do not day dram while driving
	<ul style="list-style-type: none"> ➤ Falling objects / Mechanical failure 	May prove fatal	<ul style="list-style-type: none"> ➤ Ensure effective braking system, adequate visibility for the drives, reverse warning alarm. ➤ Proper maintenance of the vehicle as per manufacturer instructions
ACTIVITY	➤ TYPE OF HAZARD	EFFECT OF HAZARD	➤ PREVENTIVE MEASURES
(I) PROOF TESTING (HYDROSTATIC/ PNEUMATIC TESTING)	<ul style="list-style-type: none"> ➤ Bursting of piping ➤ Collapse of tanks ➤ Tanks flying off 	May cause injury and prove fatal	<ul style="list-style-type: none"> ➤ Prepare test procedure & obtain CONSULTANT/ Owner's approval ➤ Provide separate gauge for pressurizing pump and piping/equipment ➤ Check the calibration status of all pressure gauges, dead weight testers and temperature recorders ➤ Take dial readings at suitable defined
			<ul style="list-style-type: none"> ➤ intervals and ensure most of them fall between 40-60% of the gauge scale range ➤ Provide safety relief valve (set at pressure slightly higher than test pressure) while testing with air/nitrogen ➤ Ensure necessary precautions, stepwise increase in pressure, tightening of bolts/ nuts, grouting, etc.



**RATE CONTRACT FOR COMPOSITE WORKS
 (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
 OF DIFFERENT TYPE OF CNG STATIONS IN BGL
 AUTHORIZED GA'S
 Bid Document No. BGL/636/2024-25**

**VOLUME II OF
 II**

			<p>before and during testing</p> <ul style="list-style-type: none"> ➤ Keep the vents open before opening any valve while draining out of water used for hydro testing of tanks ➤ Pneumatic testing involves the hazard of released energy stored in compressed gas. Specific care must therefore be taken to minimize the chance of brittle failure during a pneumatic leak test. Test temperature is important in this regard and must be considered when the designer chooses the material of construction ➤ A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 345 KPa (50 psi) or 10% of the test pressure. The gas used as test fluid, if not air, shall be nonflammable and nontoxic.
ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(J) WORKING AT HEIGHTS	Person can fall down	May sustain severe injuries or prove fatal	<p>Provide guard rails/barricade at the work place</p> <ul style="list-style-type: none"> ➤ Use PPE like safety belts, full body harness, life line, helmets, safety shoes, etc. ➤ Obtain a permit before starting the work at height above 3 meters ➤ Fall arrest systems like safety nets, etc. must

			<ul style="list-style-type: none"> ➤ be installed ➤ Provide adequate working space (min. 0.6 m) ➤ Tie/weld working platform with fixed support ➤ Use roof top walk ladder while working on a slopping roofs ➤ Avoid movement on beams
		<ul style="list-style-type: none"> ➤ May hit the scrap / material stacked at the ground or in between 	<ul style="list-style-type: none"> ➤ Keep the work place neat and clean ➤ Remove the scrap immediately
	Material can fall down	May hit the workers working at lower levels and prove fatal.	<ul style="list-style-type: none"> ➤ Same as above plus ➤ Do not throw or drop material or equipment from height ➤ All tools to be carried in a toolkit bags or on working uniform ➤ Remove scrap from the planks ➤ Ensure wearing of helmet by the workers at low level
ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	<ul style="list-style-type: none"> ➤ PREVENTIVE MEASURES
(K) CONFINED SPACES	Suffocation/ drowning	Unconscious ness, death	<ul style="list-style-type: none"> ➤ Use respiratory devices, if required ➤ Avoid over crowding inside a confined space ➤ Provide Exhaust Fans for ventilation ➤ Do not wear loose clothes, neck ties, etc. ➤ Fulfill conditions of the permit.
			<ul style="list-style-type: none"> ➤ Check for presence of hydrocarbons, O₂ level ➤ Obtain work permit before entering a confined

			<ul style="list-style-type: none"> ➤ space ➤ Ensure that the connected piping of the equipment which is to be opened is pressure free, fluid has been drained, vents are open and piping is positively isolated by a blind flange
	Presence of foul smell and toxic substances	Inhalation can pose threat to life.	<ul style="list-style-type: none"> ➤ Same as above plus ➤ Check for hydrocarbon and Aromatic compounds before entering a confined space ➤ Depute one person outside the confined space for continuous monitoring and for extending help in case of an emergency
	Ignition / flame can cause fire	Person may sustain burn injuries or explosion may occur	<ul style="list-style-type: none"> ➤ Keep fire extinguishers at a hand distance ➤ Remove surplus material and scrap immediately ➤ Do not smoke inside a confined space ➤ Do not allow gas cylinders inside a confined space ➤ Use low voltage (24V) lamps for lighting ➤ Use tools with air motors or electric tools with max. voltage of 24V ➤ Remove all equipments at the end of the day
ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	➤ PREVENTIVE MEASURES
(L) HANDLING AND LIFTING EQUIPMENTS	Failure of load lifting and moving equipments	Can cause accident and prove fatal	➤ Avoid standing under the lifted load and within the operating radius of



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

			<p>cranes Check periodically oil,</p>
			<ul style="list-style-type: none"> ➤ brakes, gears, horns and tyre pressure of all moving machinery ➤ Check quality, size and condition of all chain pulley blocks, slings, U-clamps, D-shackles, wire ropes, etc. ➤ Allow crane to move only on hard, firm and leveled ground ➤ Allow lifting slings as short as possible and check gunny packings at the friction points ➤ Do not allow crane to tilt its boom while moving ➤ Install Safe Load Indicator ➤ Ensure certification by applicable authority.
	Overloading of lifting equipments	Can cause electrocution and fire	<ul style="list-style-type: none"> ➤ Safe lifting capacity of derricks and winches written on them shall be got verified. ➤ The max safe working load shall be marked on all lifting equipments ➤ Check the weight of columns and other heavy items painted on them and accordingly decide about the crane capacity, boom and angle of erection ➤ Allow only trained operators and riggers during crane operation
	Overhead electrical	Can cause electrocution	<ul style="list-style-type: none"> ➤ Do not allow boom or other parts of crane to

	wires	n and fire	come within 3 m reach of overhead HT cables Hook and load being lifted shall preferably remain in full visibility of crane operator.
ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	➤ PREVENTIVE MEASURES
(M) SCAFFOLDING, FORMWORK AND LADDERS	Person can fall down	Person may sustain severe injuries and prove fatal	<ul style="list-style-type: none"> ➤ Provide guard rails for working at height ➤ Face ladder while climbing and use both hands ➤ Ladders shall extend about 1m above landing for easy access and tying up purpose ➤ Do not place ladders against movable objects and maintain base at ¼ unit of the working length of the ladder ➤ Suspended scaffolds shall not be less than 500 mm wide and tied properly with ropes ➤ No loose planks shall be allowed Use PPE, like helmets, safety shoes, etc.
	Failure of scaffolding material	Same as above	<ul style="list-style-type: none"> ➤ Inspect visually all scaffolding materials for stability and anchoring with permanent structures. ➤ Design scaffolding for max. load carrying capacity ➤ Scaffolding planks shall not be less than 50x250 mm full thickness lumber or equivalent. These shall be cleared or secured and must extend over the end supports by at


			<ul style="list-style-type: none"> ➤ least 150mm and not more than 300 mm ➤ Don't overload the scaffolds ➤ Do not splice short ladders to make a longer one. Vertical ladders shall not exceed 6m.
	Material can fall down	Persons working at lower level gets injured.	<ul style="list-style-type: none"> ➤ Remove excess material and scrap immediately ➤ Carry the tools in a tool-kit bag only ➤ Provide safety nets
ACTIVITY	TYPE OF HAZARD	EFFECT OF HAZARD	PREVENTIVE MEASURES
(N) STRUCTURAL WORKS	Personal negligence and danger of fall	Can cause injury or casualty	<ul style="list-style-type: none"> ➤ Do not take rest inside rooms built for welding machines or electrical distribution system ➤ Avoid walking on beams at height ➤ Wear helmet with chin strap and safety belts when working at height ➤ Use hand gloves and goggles during grinding operations ➤ Cover or mark the sharp and projected edges ➤ Do not stand within the operating radius of cranes
	Lifting / slipping of material	Same as above	<ul style="list-style-type: none"> ➤ Do not stand under the lifted load ➤ Stack properly all the materials. Avoid slippage during handling ➤ Control longer pieces lifted up by cranes from both ends ➤ Remove loose



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

<i>ACTIVITY</i>	<i>TYPE OF HAZARD</i>	<i>EFFECT OF HAZARD</i>	<p>materials from height Ensure tightening of all nuts and bolts</p> <p>➤ PREVENTIVE MEASURES</p>
(O) PIPELINE WORKS	Erection/ lowering failure	Can cause injury	<p>➤ Do not stand under the lifted Load</p> <p>➤ Do not allow any person to come within the radii of the side boom handling pipes</p> <p>➤ Check the load carrying capacity of the lifting tools and tackles Use safe Load</p>
			<p>Indicators Use appropriate PPEs</p>
	Other	Same as above	<p>➤ Wear gum boots in marshy areas</p> <p>➤ Allow only one person to perform signaling operations while lowering of pipes</p> <p>➤ Provide night caps on pipes Provide end covers on pipes for stoppage of pigs while testing/cleaning operations.</p>

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
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FORMAT NO. : HSE-1, REV. 0

HSE CHECKLIST CUM COMPLIANCE REPORT (1/6)

Project:	Contractor :
Date:	Owner :
Inspection By:	Report No. :
Frequency : Fortnightly	Job No :

Note: write 'NA' wherever the item is not applicable

SL. NO.	ITEM	YES	NO	REMARKS
1	HOUSEKEEPING			
a)	Waste containers provided and used			
b)	Sanitary facilities adequate and clean			
c)	Passageways and Walkways clear			
d)	General neatness of working areas			
e)	Others			
2	PERSONNEL PROTECTIVE EQUIPMENT			
a)	Goggles; Shields			
b)	Face protection			
c)	Hearing protection			
d)	Safety shoes			
e)	Hand protection			
f)	Respiratory Masks etc.			
g)	Safety Belts			
h)	Safety Helmet/Hard Hat			
I)	Others			
3	EXCAVATIONS/OPENINGS			
a)	Openings properly covered or barricaded			
b)	Excavations shored			
c)	Excavations barricaded			
d)	Overnight lighting provided			
e)	Others			
4	WELDING & GAS CUTTING			
a)	Gas cylinders chained upright			
b)	Cables and hoses not obstructing			
c)	Screens or shields used			
d)	Flammable materials protected			
e)	Fire extinguisher(s) accessible			
f)	Others			
5	SCAFFOLDING			
a)	Fully decked platforms			
b)	Guard and intermediate rails in place			
c)	Toe boards in place			



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

d)	Adequate shoring			
e)	Adequate access			
SL. NO.	ITEM	YES	NO	REMARKS
f)	Others			
6	LADDERS			
a)	Extension side rails 1m above			
b)	Top of landing			
c)	Properly secured			
d)	Angle + 70 from horizontal			
e)	Others			
7	HOISTS, CRANES AND DERRICKS			
a)	Condition of cables and sheaves OK			
b)	Condition of slings, chains, hooks and eyes OK			
c)	Inspection and maintenance logs maintained			
d)	Outriggers used			
e)	Signs/barricades provided			
f)	Signals observed and understood			
g)	Qualified operators			
h)	Others			
8	MACHINERY, TOOLS AND EQUIPMENT			
a)	Proper instruction			
b)	Safety devices			
c)	Proper cords			
d)	Inspection and maintenance			
e)	Others			
9	VEHICLE AND TRAFFIC			
a)	Rules and regulations observed			
b)	Inspection and maintenance			
c)	Licensed drivers			
d)	Others			
10	TEMPORARY FACILITIES			
a)	Emergency instructions posted			
b)	Fire extinguishers provided			
c)	Fire-aid equipment available			
d)	Secured against storm damage			
e)	General neatness			
f)	In accordance with electrical requirements			
g)	Others			
11	FIRE PREVENTION			
a)	Personnel instructed			
b)	Fire extinguishers checked			
c)	No smoking in Prohibited Areas			
d)	Hydrants Clear			

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

e)	Others			
12	ELECTRICAL			
a)	Use of 3-core armoured cables			
SL. NO.	ITEM	YES	NO	REMARKS
b)	Usage of 'All insulated' or 'double insulated' electrical tools			
c)	All electrical connection are routed through ELCB			
d)	Natural Earthing at the source of power (main DB)			
e)	Continuity and tightness of earth conductor			
f)	Covering of junction boxes, panels and other energized wiring places			
g)	Ground fault circuit interrupters provided			
h)	Prevention of tripping hazards			
i)	Others			
13	HANDLING AND STORAGE OF MATERIALS			
a)	Properly stored or stacked			
b)	Passageways clear			
c)	Others			
14	FLAMMABLE GASES AND LIQUIDS			
a)	Containers clearly identified			
b)	Proper storage			
c)	Fire extinguishers nearby			
d)	Others			
15	WORKING AT HEIGHT			
a)	Erection plan and work permit obtained			
b)	Safety nets			
c)	Full body harness and lanyards; chute lines			
d)	Health Check record available for workers going up?			
e)	Others			
16	CONFINED SPACE			
a)	Work permit obtained			
b)	Test for toxic gas and sufficient availability of oxygen conducted			
c)	At least one person outside the confined space for monitoring deputed			
d)	Availability of sufficient means of entry, exit and ventilation			
e)	Fire extinguishers and first-aid facility ensured			
f)	Lighting provision made by using 24V			

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

	lamps			
g)	Proper usage of PPEs ensured			
17	RADIOGRAPHY			
a)	Proper storage and handling of source as per BARC / AREB guidelines			
SL. NO.	ITEM	YES	NO	REMARKS
d)	Use of appropriate PPE's ensured			
e)	Proper training to workers/supervisors imparted			
f)	Minimum occupancy of workplace ensured			
18	HEALTH CHECKS			
a)	Workers medically examined and found to fit for working : i) At heights In confined space.			
b)	Availability of First-aid facilities			
c)	Proper sanitation at site, office and labour camps			
d)	Arrangement of medical facilities			
e)	Measures for dealing with illness			
f)	Availability of Portable drinking water for workmen & staff			
g)	Provision of crèches for children			
h)	Stand by vehicle available for evacuation of injured.			
19	ENVIRONMENT			
a)	Chemical and other effluents properly disposed			
b)	Cleaning liquid of pipes disposed off properly			
c)	Seawater used for hydro-testing disposed off as per agreed procedure			
d)	Lubricant Waste/Engine oils properly disposed			
e)	Waste from Canteen, offices, sanitation etc. disposed properly			
f)	Disposal of surplus earth, stripping materials, oily rags and combustible materials done properly			
g)	Green belt protection			

Signature of Engineer with Seal



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

FORMAT NO. : HSE-2, REV. 0

ACCIDENT / INCIDENT REPORT

(To be submitted by Contractor after every Accident / Incident within 24 hours)

Name of Site:-
CONTRACTOR

Report No:
Date:

Type of Accident / Incident : Fatal Other Lost Time Non Loss Time First-Aid case

NAME OF THE
INJURED.....
AGE

.....
FATHER'S
NAME.....

SUB-CONTRACTOR
M/S.....

DATE & TIME OF
ACCIDENT.....

LOCATION
.....

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY/DAMAGE

MEDICAL AID PROVIDED/ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES (IF APPLICABLE)

DATE:

SIGNATURE OF CONTRACTOR
WITH SEAL

To : OWNER.....

1 COPY



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

: RCM/SITE-IN-CHARGE, PMC 3 COPIES

FORMAT NO. : HSE-3, REV. 0

SUPPLEMENTARY ACCIDENT / INCIDENT INVESTIGATION REPORT

Supplementary to Report No: (Copy enclosed)

Project: Site:
 Name of Work : Date:
 Contractor: Work Order / LOI No. :

NAME OF THE INJURED

AGE :

SUB-CONTRACTOR
 M/S.....

DATE & TIME OF ACCIDENT / INCIDENT

LOCATION

BRIEF DESCRIPTION & CAUSE OF A ACCIDENT/ INCIDENT

NATURAL OF INJURY/DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICTIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER.

DATE: SIGNATURE OF CONTRACTOR
WITH SEAL

To : OWNER..... 1 COPY
 : RCM/SITE-IN-CHARGE, PMC 3 COPIES



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

FORMAT NO. : HSE-4, REV. 0

NEAR MISS INCIDENT – SUGGESTED PROFORMA

Name of Site :
Name of Work :

Report No:
Date :
Contractor :

INCIDENT REPORTED BY :

DATE & TIME OF INCIDENT :

LOCATION :

BRIEF DESCRIPTION OF INCIDENT

PROBABLE CAUSE OF INCIDENT


SUGGESTED CORRECTIVE ACTION

STEPS TAKEN TO AVOID RECURRENCE YES NO

DATE:

SIGNATURE OF CONTRACTOR
WITH SEAL

To : OWNER..... 1 COPY
: RCM/SITE-IN-CHARGE, PMC 3 COPIES

 Bhagyanagar Gas Limited	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
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FORMAT NO. : HSE-5, REV. 0

MONTHLY HEALTH, SAFETY & ENVIRONMENT (HSE) REPORT
(To be submitted by each Contractor)

Actual work start Date:
 Project:
 Name of the Contractor:
 Name of Work:

For the Month of:
 Report No:
 Status as on:
 Name of Safety officer:

ITEM		UPTO PREVIOUS MONTH	THIS MONTH	CUMULATIVE
a)	Average number of Staff & Workmen (average daily headcount, not man days)			
b)	Manhours Worked			
c)	Number of HSE meeting organized at site			
d)	Number of HSE awareness programmes conducted at site			
e)	Number of Lost Time Accidents (LTA)	Fatal		
		Other LTA		
f)	Number of Loss time Injuries (LTI)	Fatalities		
		Other LTI		
g)	Number of Loss Time Accidents			
h)	Number of First Aid Cases			
i)	Number of Near Miss Incidents			
j)	Man-days lost due to accidents			
k)	LTA Free Manhours i.e. Number of LTA free manhours from the Lst LTA			
l)	Compensation cases raised with Insurance			
m)	Compensation case resolved and paid to workmen			
n)	Whether workmen compensation policy taken	Y/N		
o)	Whether workmen compensation policy valid	Y/N		
p)	Whether workmen registered under ESI Act	Y/N		
Remark				

DATE:

Safety Officer /Resident Engineer
 (Signature and Name)



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

To : OWNER
: RCM/, PMC (2 COPIES)

FORMAT NO. : HSE-6, REV. 0

PERMIT FOR WORKING AT HEIGHT (ABOVE 2 METER)

Project Site : Sr. No.:
 Name of the work: Date:
 Name of Contractor : Nature of Work :
 Total No.of Workers: Exact location of work :
 Duration of work: from to

The following items have been checked and compliance shall be ensured during the currency of the permit:

Sl.	ITEM	DONE	NOT REQD.
1.	Equipment/Work Area inspected		
2.	Considered hazard from other routine/non-routine operations and concerned person alerted		
3.	ELCB provided		
4.	Proper lighting provided		
5.	Area cordoned off.		
6.	Precautions against public traffic taken		
7.	Sound Scaffolding provided		
8.	Adequate protected Platform provided		
9.	Acces and Exit to the area (Ladder properly fixed)		
10.	Floor Openings covered		
11.	Safety Net provided		
12.	Heath check of personnel		

A. Following personal protective equipment are provided (mark) and used as relevant Safety helmet/Gloves/Goggles/Shoes/Face Shield/Life Line/Safety Belt/Safety Harness.

- B. This permit shall be available at the work site at all times.
- C. Permit shall be issued for maximum one week only (Monday to Sunday).
- D. This permit shall be applicable in non-operational areas.
- E. After completion of the work, used permits shall be preserved for record purposes.
- F. Additional precautions, if any


Permission is granted to work (See overleaf) = Yes/No

Name of Contractor’s Supervisor (Initiator)	Name of Contractor’s Safety Officer (Issuing Authority)
------------------------------------------------	------------------------------------------------------------

GRANT OF PERMIT AND EXTENSIONS

Sl. No.	Validity Period From To	Work time FromHrs. ToHrs	Initiator (Supervisor of Contractor)	Issuing Authority (Safety Officer) of Contractor	Verification by CONSULTANT with date

Additional safety instructions, if any.

 Bhagyanagar Gas Limited	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
--------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

CONFINED SPACE ENTRY PERMIT


Project Site : Sr. No.:
 Name of the work: Date:
 Name of Contractor : Nature of Work :
 Exact location of work :

Safety Requirements : POSITIVE ISOLATION OF THE VESSEL IS MANDATORY

(A) Has the equipment been ?					
Y	NR		Y	NR	
<input type="checkbox"/>	<input type="checkbox"/>	isolated from power / steam / air	<input type="checkbox"/>	<input type="checkbox"/>	water flushed &/or steamed
<input type="checkbox"/>	<input type="checkbox"/>	isolated from liquid or gases	<input type="checkbox"/>	<input type="checkbox"/>	Manways open & ventilated
<input type="checkbox"/>	<input type="checkbox"/>	depressurized &/or drained	<input type="checkbox"/>	<input type="checkbox"/>	cont. inset gas flow arranged
<input type="checkbox"/>	<input type="checkbox"/>	blanked / blinded / disconnected	<input type="checkbox"/>	<input type="checkbox"/>	adequately cooled
					radiation sources removed
					Proper lighting provided

(B) Expected Residual Hazards					
Y	NR		Y	NR	
<input type="checkbox"/>	<input type="checkbox"/>	lack of O ₂	<input type="checkbox"/>	<input type="checkbox"/>	combustible gas / liquid
<input type="checkbox"/>	<input type="checkbox"/>	corrosive chemicals	<input type="checkbox"/>	<input type="checkbox"/>	pyrophoric iron / scales
<input type="checkbox"/>	<input type="checkbox"/>	Heat / steam / frost	<input type="checkbox"/>	<input type="checkbox"/>	high humidity
<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
					H ₂ S / toxic gases
					electricity / static
					ionizing radiation

(C) Protective Measures					
Y	NR		Y	NR	
<input type="checkbox"/>	<input type="checkbox"/>	gloves	<input type="checkbox"/>	<input type="checkbox"/>	ear plug / muff
<input type="checkbox"/>	<input type="checkbox"/>	protective clothing	<input type="checkbox"/>	<input type="checkbox"/>	dust / gas / air line mask
<input type="checkbox"/>	<input type="checkbox"/>	Grounded air educator / blower / AC	<input type="checkbox"/>	<input type="checkbox"/>	attendant with SCBA / air mask
<input type="checkbox"/>	<input type="checkbox"/>	Fire fighting arrangements	<input type="checkbox"/>	<input type="checkbox"/>	safety harness & lifeline
<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
					goggles / face shield
					personal gas alarm
					rescue equipment / team
					communication equipment

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Authorization / Renewal (It is safe to enter the confirmed space)

Date

No. of Persons Allowed

Name of Persons allowed

Signature Contractor's Supervisor

Signature Contractor's Safety Officer

Time From To

Workman

Permit Closure :

- (A) Entry was closed stopped will
continue on
- (B) Site left in a safe condition
 Housekeeping done
- (C) Multi lock removed key transferred
 Ensured all men have come out Manways barricaded

Remarks, if any :



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

FORMAT NO. : HSE-8, REV. 0

RADIATION WORK PERMIT

Project : Sr. No.:
Name of the work : Date:
Name of Contractor : Job No. :

Location of work :

Source Strength :

Cordoned distance (m) :

Name of Radiographing agency : Approved by Owner / PMC

The following items have been checked & compliance shall be ensured during currency of the permit :

S. No	Item Description	Done
1.	Safety regulations as per BARC/AERB ensured while source in use/ in transit & during storage.	<input type="checkbox"/>
2.	Area cordoned off.	<input type="checkbox"/>
3.	Lighting arrangements for working during nights ensured.	<input type="checkbox"/>
4.	Warning signs / flash lights installed.	<input type="checkbox"/>
5.	Cold work permit taken (if applicable)	<input type="checkbox"/>
6.	PPEs like film badges, dosimeters used.	<input type="checkbox"/>

Additional precautions, if any

(Radiography Agency's BARC / AREB authorized Supervisor)

(Contractor's Safety Officer)

Permission is granted


Permit is valid from _____ AM/PM _____ Date to _____ AM/PM _____ Date

(Signature of permit issuing authority)

Name :

Designation :

Date :

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Permit renewal :

Permit extended upto		Additional precautions required, if any.	Sign of issuing authority with date
Date	Time		

Work completed / stopped / area cleared at _____ Hrs. of Date ____

Sign of permit issuing authority)

Name :



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

FORMAT NO. : HSE-9, REV. 0

RADIATION WORK PERMIT

Project :
Name of the work :
Name of Contractor :
Name of Contractor :

Sr. No.:
Date:
Job No. :

Line No. / Equipment No. /Structure to be dismantled :

Location details of dismantling / demolition with sketch : (Clearly indicate the area)

The following items have been checked & compliance shall be ensured during currency of the permit :

S. No	Item Description	Done	Not Applicable
1.	Services like power, gas supply, water, etc. disconnected.	<input type="checkbox"/>	<input type="checkbox"/>
2.	Dismantling / Demolishing method reviewed & approved.	<input type="checkbox"/>	<input type="checkbox"/>
3.	Usage of appropriate PPEs ensured.	<input type="checkbox"/>	<input type="checkbox"/>
4.	Precautions taken for neighboring structures	<input type="checkbox"/>	<input type="checkbox"/>
5.	First-Aid arrangements made	<input type="checkbox"/>	<input type="checkbox"/>
6.	Fire fighting arrangements ensured	<input type="checkbox"/>	<input type="checkbox"/>
7.	Precautions taken for blasting	<input type="checkbox"/>	<input type="checkbox"/>

(Contractor's Supervisor) (Contractor's Safety Officer)

Permission is granted.


(Permit issuing authority) Name :

Date :

Completion Report :

Dismantling / Demolishing is completed on Date at Hrs.


Materials / debris transported to identified location

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Tagging completed (as applicable)

Services like power, gas supply, water, etc. restored

(Permit issuing authority)

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

RECOMMENDED VENDOR LIST (SS TUBING & MECHANICAL)



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Sr no.	Item Code/Description	Remarks
(I)	SS TUBES	
1	M/s Sandvik Sweden	
2	M/s Tubacex Austria	
3	M/s Ratnamani Metals & Tubes Ltd.	
(II)	SS FITTINGS & VALVES	
1	M/s Parker Hannifin Corporation, USA C/O M/s Parker Hannifin Corporation India Pvt. Ltd. India	
2	M/s Swagelok CO, USA,C/O Bangalore fluid system component Pvt. Ltd.	
3	M/s Parker Hannifin India Pvt. Ltd.	
4	M/s SSP. U.S.A	
5	M/s Dk-lokCorp.,South Korea only for SS fittings	
6	M/s Hylok, South Korea only for SS fittings	
7	M/s Astec fittings	
	SS TUBE CLAMPS	
	Swagelok/ Parker/ Dk-Lok/ Vaishnavi hydraulics Pvt. Ltd./ Vardhaman bearings / AK industries	
	CNG high pressure hose: Swagelok/ Parker/Eaton Synflex / OPW	
(III)	FLANGES & FORGED FITTINGS SPECTACLE BLINDS	
1	C D ENGINEERING CO. GHAZIABAD	
2	CHW Forging Pvt. Ltd. Ghaziabad	
3	Sanghvi Forging Pvt. Ltd. Vadodara	
4	Good Luck Engineering Co./ Good Luck India Ltd. Ghaziabad	
5	Utsah Engineering Pvt. Ltd.	
6	Fit Tech Industries Pvt.	
7	Jindal Forgings Pvt. Ltd.	
8	Triveni Refractories Pvt.	
9	Shakti Forge Industries	
10	A M Engineers	
11	Kunj Forging (P) Ltd. Ghaziabad	
(IV)	PIPE FITTINGS	
1	Sawan Engineers Pvt. Ltd. Vadodara	
2	Gujarat Infra Pipes Ltd. Vadodara	
3	A M Engineers, Thane	
4	Tube Products Incorporate, Vadodara	
5	Teekay Tubes Pvt Ltd.	
6	Topaz Piping Industries Vadodara	
7	Paras Fittings Pvt. Ltd., Thane	
8	Dee Development Engineer (Dee Piping Systems), Palwal	
9	Jindal Forgings Pvt. Ltd.	
(V)	FASTENERS	
1	Consol Engineering & Fasteners Industries, Howrah	
2	Pacific Forging & Fasteners Pvt. Ltd. Mumbai	
3	Precision Auto Engineers Ludhiana	
4	Precision Engg. Industries India	
5	Deepak Fasteners Ltd. Ludhiana	
6	AEP Company, Anand	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

7	Hardwin Fasteners Ltd. Mumbai	
8	President Engineering Works, Mumbai	
9	Syndicate Engineering Industries, Mumbai	
10	Pioneer Nuts and Bolts Pvt. Ltd. Mumbai	
11	Hem Industries Mumbai	
12	FASTNERS & ALLIED PRODUCTS PVT. LTD., HUBLI	
13	Multi Fasteners Pvt. Ltd. Vadodara	
14	MULTI THREAD FASTENERS, VADODARA	
15	NEXO INDUSTRIES LIMITED, LUDHIANA	

16	UDHERA FASTNERS LTD. LUDHIANA	
17	MEGA ENGINEERING PRIVATE LIMITED, NAVI MUMBAI	
(VI)	GASKETS (SPIRAL WOUND METALLIC GASKETS)	
1	IGP ENGINEERS PRIVATE LTD., CHENNAI	
2	GOODRICH GASKETS PVT LTD., CHENNAI	
3	UNI HUNGER LIMITED, NEW DELHI	
4	STARFLEX SEALING INDIA PVT. LTD., MUMBAI	
5	MADRAS INDUSTRIAL PRODUCT, CHENNAI	
6	GASKET INDIA PRIVATE LTD., CHENNAI	
(VII)	CARBON STEEL PIPE (ASTM A106 Gr. B & A333 Gr.6/ IS GRADE PIPES)	
1	HEAVY METAL & TUBES LTD., MEHSANA	
2	ISMT LIMITED	
3	JINDAL SAW LTD.	
4	MAHARASHTRA SEAMLESS LIMITED	
5	MAHALAXMI METAL CORPORATION	
6	SAINEST TUBES PVT. LTD.	
7	RATNADEEP METAL & TUBES LTD.	
8	JFE STEEL CORPORATION	
9	MANNESMANN S.A	
10	ARCELORMITTAL TUBULAR PRODUCTS ROMAN SA	
11	SUMITOMO METAL IND.LTD	
12	NIPPON METAL INDUSTRY CO	
13	TENARIS	
	NOTE: 1. TRADERS/ SUPPLIERS/ STOCKIST ARE ALSO ACCEPTABLE AND SHALL PROCURE THE PIPES FROM THE ABOVE LIST OF MANUFACTURES	
(VIII)	CARBON STEEL PIPES (AP15LGRDAE)	
1	MAHARASHTRA SEAMLESS LIMITED Ltd., NAGOTHANE- FOR UP TP 18" ERW PIPES & SMLS PIPES OF UP TO 16"	
2	WELSPUN CORP LTD. FOR UP TO 16" ERW PIPES & SAW PIPES OF 18" & ABOVE	
3	M/s Ratnamani Metals & Tubes Ltd. FOR UP TO 18" ERW PIPES & SAW PIPES OF 18" & ABOVE	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

4	JINDAL INDIA LTD - FOR UP TO 18" ERW PIPES	
5	BHUSHAN STEEL LIMITED- FOR UP TO 18" ERW PIPES	
6	JINDAL SAW — FOR 16" & ABOVE SAW PIPES	
7	SURYA KOSHINI LTD-- FOR UP TO 16" ERW PIPES & SAW PIPES OF 18" & ABOVE.	
(IX)	API 600/602 GATE VALVE (HOV)	
1	NITON VALVE INDUSTRIES PVT LTD	
2	MICON VALVES (INDIA) PVT LTD., MUMBAI	
3	STEEL STRONG VALVES, NAVI MUMBAI	
4	LEADER VALVES LIMITED	
5	OCEAN VALVE MANUFACTURING CO.	
6	HAWA ENGINEERS LTD.	
7	SHALIMAR VALVES PVT. LTD	
8	LARSEN & TOUBRO LTD	
9	FOURESS ENGG (I) LTD. (AURANGABAD)	
10	ZED VALVES CO. PVT. LTD.	
11	MH VALVES LTD.	
12	NSSL PVT. LTD.	
(X)	API 6D BALL VALVES (HOV)	
1	VIRGO ENGINEERS LTD.	
2	LARSEN & TOUBRO LTD.	
3	MICROFINISH VALVES LTD, DHARWAD	
4	FLOWCHEM INDUSTRIES, GANDHINAGAR	
5	CAMERON ITALY SRL	
6	MSA A.S.	
7	PETROL VALVES SRL	
8	VALVITALIA, ITALY	
9	PTPA, RUSSIA/MIDDLE EAST	
(XI)	API 6D GATE VALVE (HOV)	
1	L&T VALVES LIMITED, COIMBATORE	
2	STEEL STRONG VALVES. NAVI MUMBAI	
3	VALVITALIA, ITALY	
4	HINA INDUSTRIES, AHMEDABAD	
5	HAWA VALVES (I) PVT. LTD., NAVI MUMBAI	
6	HAWA ENGINEERS LIMITED, AHMEDABAD	
7	WEIRBDK (WEIRFLOW CONTROL INDIA), HUBLI	
8	FLOWCHEM INDUSTRIES, GANDHINAGAR	
9	FLOWSERVE INDIA CONTROLS PRIVATE LIMITED, CHENNAI	
(XII)	BS 5351/ISO 17292 BALL VALVES (FIRE SAFE)	
1	L&T VALVES LIMITED, COIMBATORE	
2	STEEL STRONG VALVES. NAVI MUMBAI	
3	VIRGO ENGINEERS LTD	
4	MICROFINISH VALVES LTD, DHARWAD	
5	WEIRBDK (WEIRFLOW CONTROL INDIA), HUBLI	
6	FLOWCHEM INDUSTRIES, GANDHINAGAR	
7	BELGAUM AQUA VALVES PVT. LTD.	
(XIII)	ISO 15761 GLOBE VALVE/API 623 GLOBE VALVE	
1	WEIR BDK (WEIR FLOW CONTROL INDIA), HUBLI	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

2	LARSEN & TOUBRO LTD	
3	FLOWTECH INDUSTRIES	
4	MH VALVES PVT. LTD	
5	SHAYBURG VALVES PVT. LTD.	
6	FOURESS ENGG (I) LTD. (AURANGABAD)	
7	STEEL STRONG VALVES INDIA PVT LTD	
8	SHALIMAR VALVES PVT LTD	
9	LEADER VALVES LTD	
10	NITON VALVE INDUSTRIES PRIVATE LTD.	
11	KSB	
(XIV)	API 6D PLUG VALVES	
1	L&T VALVES LIMITED, COIMBATORE	
2	GHATGE PATIL INDUSTRIES LTD., KOLHAPUR	
(XV)	RELIEF VALVES & SAFETY VALVES (TRV/TSV/PSV)	
1	TYCO SANMAR, TRICHY/ ANDERSON GREENWOOD CROSBY (PENTAIR SANMAR)	
2	BLISS ANAND PVT LTD., CHENNAI	
3	LESER GMBH & CO.	
4	WEIR BDK VALVES	
5	UNI KLINGER LTD.	
(XVI)	STRAINER (BASKET/'Y'/ CONICAL TYPE)/ END FUNNEL	
1	GRANDPRIX (P) LTD., NEWDELHI	
2	MULTITEX FILTRATION ENGINEERES PVT. LTD., NEW DELHI	
3	RAK DIN ENGINEERS, NEW DELHI	
4	PETROMAR ENGINEERED SOLUTION PVT LTD	
5	FILTER CONCEPT, AHMEDABAD	
(XVII)	WELDING ELECTRODES	
1	ESAB INDIA LTD.	
2	ADVANI ORLIKON	
3	D & H SECHRON ELECTRODES LTD	
4	BOHLE R	
5	LINCOLN ELECTRIC	
6	HONAVAR ELECTRODES LTD.	
7	MODI ARC ELECTRODES CO	
8	GEE LIMITED	
9	D & H WELDING	
10	MODI HITECH INDIA LIMITED	
(XVIII)	PORTABLE FIRE FIGHTING EQUIPMENTS	
1	N K FIRE & SAFETY (A DIV. OF NEW AGE FIRE FIGHTING CO. LTD.), SURENDRANAGAR	
2	BRUBASI HI-TECH UDYOG LTD. NEW DELHI	
3	JOSEPH LESLIE DRAGER MFG.PVT LTD, MUMBAI	
4	B L HEALTH & SAFETY PVT LTD., NEW DELHI	
5	SHAH BHOGILAL JETHALAL & BROTHERS, AHMEDABAD	
6	INTEGRATED FIRE PROTECTION PVT LTD., KOLKATA - 700020	
7	ZENITH FIRE SERVICES (INDIA) PVT LTD, NAVI MUMBAI	
8	UNITED FIRE EQUIPMENTS PVT LTD, NEW DELHI	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

9	HITECH SAFETY EQUIPMENT, DELHI	
10	CHAWLA FIRE PROTECTION ENGINEERS, BAHADURGARH	
11	SAFEX FIRE SERVICES, THANE	
12	NITIN FIRE PROTECTION INDUSTRIES LTD., AHMEDNAGAR	
13	NEW BHARAT FIRE PROTECTION SYSTEM (PVT.) LTD., THANE	
14	CO2 FYCO., MUMBAIII., MUMBAI	
(XIX)	EXTERNAL COATING MATERIAL FOR U/G PIPING (100% SOLIDS HB LIQUID EPOXY)	
1	3M (SCOTCHKOTE 312 PART A/B)	
2	SEAL FOR LIFE INDIAPVT. LTD.(POWERCRETE R-95)	
(XX)	EXTERNAL COATING MATERIAL FOR U/G PIPING (100% SOLIDS POLYURETHANE)	
1	3M (SCOTCHKOTE URETHANE COATING 165 HBL/ 165 HBLBG)	
2	AMCHEM PRODUCTS PVT. LTD. (PURETHANE NXT/ PLX)	
3	TIB CHEMICALS (PROTEGOL UR — COATING 32.45 R)	
4	RHINO LININGS CORPORATION	
5	CARBOLINE PAINTS (POLYCLAD-777)	
(XXI)	RADIOGRAPHIC INSPECTION	
1	CORROSION CONTROL SERVICES (B) PVT LTD., MUMBAI	
2	INDUSTRIAL X-RAY & ALLIED RADIOGRAPHERS (I) PVT. LTD., MUMBAI (IXAAR)	
3	SIEVERT INDIA LTD., MUMBAI	
4	OPI SERVICES (INDIA) PVT. LTD., PUNE	
5	OFFSHORE TESTING & INSPECTION SERVICES (I) PVT. LTD., NAVIMUMBAI	
6	SIGMA NDT SERVICES, MUMBAI	
7	CALCUTTA TEST HOUSE PVT. LTD., NEW DELHI	
8	NDT SERVICES, AHMEDABAD	
9	GEECY INDUSTRIAL SERVICES PVT. LTD., MUMBAI	
10	PERFECT METAL TESTING & INSPECTION AGENCY, KOLKATA	
11	INTER OCEAN SHIPPING CO., NEW DELHI	
12	RTD, MUMBAI	
13	X-TECH, VIZAG	
14	EMINENT NDT SERVICES PVT. LTD., CHENNAI (UPTO 18"OD SIZE)	
(XXII)	ELECTRO-FORGED GRATINGS	
1	BHOLA RAM STEELS PVT. LTD. PATNA	
2	GREATWELD STEEL GRATINGS PVT. LTD. PUNE	
3	INDIANA GRATINGS PVT. LTD. MUMBAI	
4	KANADE ANAND UDYOG PVT. LTD. MUMBAI	
5	PINAX STEEL INDUSTRIES PVT. LTD. KOLKATA	
6	VINFAB GRATINGS MUMBAI	
(XXIII)	FLOW/ PRESSURE CONTROL VALVES	
1	M/S FORBES MARSHALL	
2	M/S ABB LTD.	
3	M/S FISHER XOMOX /EMERSON	
4	M/S SEVERN GLOCON	
5	M/S INSTRUMENTATION LTD	
6	M/S MIL CONTROLS LTD.	
7	M/S SAMSON CONTROL	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

8	M/S DRESSER	
9	M/S KOSO	
10	M/S FORBES MARSHALL	
(XXIV)	INSULATING COUPLING	
1	VEE KAY VIKRAM & CO. LLP., AHMEDABAD	
2	IGP ENGINEERS PVT. LTD., CHENNAI	
(XXV)	PRESSURE GAUGE	
1	AN INSTRUMENTS PVT LTD INDIA	
2	BAUMER TECHNOLOGIES INDIA PVT LTD	
3	BUDERBERG GAUGE CO	
4	BADOTHERM PROCE55 INSTRUMENTS B.V	
5	GAUGES BURDEN PVT LTD(GEN EAST)	
6	GURU INSTRUMENTS (SOUTH INDIA) PVT LTD	
7	H GURU INDUSTRIES	
8	MANOMETER INDIA PVT LTD	
9	WIKA INSTRUMENT INDIA PVT LTD	
10	WALCHANDNAGAR INDUSTRIES LTD INDIA	
11	WIKA ALEXENDERWIEG AND& CO GMBH GERMANY CO WIKAINSTRUMENTS INDIA	
12	PRESICIONC MASS PRODUCTS	
13	GENERAL INSTRUEMNTS	
14	SWITZER INSTRUMETNS LIMITED	
15	DELTA CONTROLS LIMITED	
16	SOR MEASUREMENT & CONTROLS	
17	ITT-BARTON	
18	CUSTOM CONTROLS SENSORS INC.	
19	GOA INSTRUMENTS INDUSTRIES PVT LTD	
(XXVI)	TEMP. GAUGES (BI METALLIC, FILLED SYSTEM)	
1	AN INSTRUMENTS PVTLTD INDIA	
2	BAUMER TECHNOLOGIES INDIA PVT LIMITED	
3	BADOTHERM PROCE55 INSTRUMENTS B.V	
4	H GURUINSTRUMENTS (SOUTH INDIA) PVT LTD	
5	H GUR INDUSTRIES	
6	WIKA INSTRUMENT INDIA PVT LTD	
7	WIKA ALEXENDERWIEG AND& CO GMBH GERMANY CO WIKAINSTRUMENTS INDIA	
8	GOA INSTRUMENTS INDUSTRIES PVT LTD	
9	PRESICIONC MASS PRODUCTS	
10	GENERAL INSTRUEMNTS	
11	SWITZER INSTRUMETNs LIMITED	
12	DELTA CONTROLS LIMITED	
13	SOR MEASUREMENT & CONTROLS	
14	ITT-BARTON	
15	CUSTOM CONTROLS SENSORS INC.	
16	GOA INSTRUMENTS INDUSTRIES PVT LTD	
17	GAUGES BURDON	
18	WALCHANDNAGAR INDUSTRIES LTD INDIA	

(XXVII).LIST OF APPROVED PAINT MANUFACTURERS AND THEIR ACCEPTABLE BRANDS FOR ABOVE GROUND PIPING/TANKS/VALVES/EQUIPMENTS:

NAME OF PAINT	BERG ER PAINTS	ASIAN PAINTS	AKZO NOBEL PAINT	NAME OF PAINT	BERG ER PAINTS	ASIAN PAINTS	AKZO NOBEL PAINT	NAME OF PAINT	BERG ER PAINTS
ETHYL ZINC SILICATE PRIMER	ZINC ANODE 304 MZ	APCOSIL 605	INTERZINC 12	SIGMAZINC 158	DIMETCO 9	HEMP EL GALVOSIL 15700	RESIST 86	CARBOZINC 11	ZONC-0-SIL75
POLYAMIDE CURED HIGH BUILD EPOXY ZINC PHOSPHATE PRIMER	EPLIUX 13 HB PRIMER	APCODUR EHB ZINC PHOSPHATE PRIMER	INTERGRAD 251	SIGMACOVER 256	AMERCOAT 68 HS	HEMP ADUR FAST DRY 15590	PENGUARD EXPRESS/JOTAGUARD ZN PHOSPHATE	CARBORGUARD 193 HBZPP	PENTADUR HBZP 8531
POLYAMIDE CURED EPOXY HIGH BUILD MIO	EPLIUX 455 HB MIO	APCODUR EPOXY HS MIO	INTERGRAD 475 HS	SIGMACOVER 435	AMERLOCK 400 MIO	HEMP ADUR MASTIC 47550	PENGUARD EXPRESS MIO	CARBORGUARD 893	PENTADUR HB MIO 5569
ALIPHATIC ISOCYANATE POLYURETHANE	BERGERTHANE 41 S/GPU FINISH	APCOTHANE HBPU FINISH	INTERTHANE 990	SIGMA DUR 520	AMERCOAT 450 HS	HEMPALIN 12050	HARD TOP XP	CARBOTHANE 134 HG	PENTATHANE HS 4510



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

FINISH PAINT		H/ APCOT HA NE CF678							
POLY AMI DE CURED HIGH	EPI LUX 89 HIGH BUILT	APC OD UR EPOXY	INTER GAR D 410	SIGM AC O VER 456	AMER CO AT 385	HE MP AT HANE TOPC	PEN GU AR D EXPRE S S	C A R B O N G UAR D	PENTA DUR HI-BUILD S520

BUILD EPOXY FINISH PAINT	FINISH	420 HS				OA T 5593 0		193 H B ZP P	
SOLVENT FREE EPOXY PAINT	EPILUX STL	APCO GUA RD SF 725	INTER LINE 910	SIGM AG A URD 603	AMER CO AT 351	To be furni sh ed	To be furni sh ed	PH E N LI NE 341	PENTAD UR SOLVEN T LESS EPOXY
HIGH BUILD COAL TAR	EPILUX 555 COAL TAR EPOXY	APCO DUR CF 655	INTER TUF 262	To be furni sh ed	AMERL OC K 78 HB	To be furni sh ed	To be furni sh ed	To be furni sh ed	To be furni sh ed
EPOXY PAINT	HIGH BUILD								
HIGH BUILD BITUMEN COATING	BISON HIGH BUILD BLACK	ASIAN SUPER SERVIC E HIGH BUILD BLACK	INTER TUF 16	To be furni sh ed	EQUIV AL ENT	To be furni sh ed	To be furni sh ed	To be furni sh ed	To be furni sh ed




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

NOTE:

1. APART FROM THE VENDORS DETAILED IN THE ABOVE LIST OR ITEMS WITH NO VENDOR LIST, THE CONTRACTOR MAY PROPOSE ANY OTHER VENDOR HAVING CREDENTIALS FOR SUPPLY OF RESPECTIVE ITEMS (FOR THE SAME OR HIGHER SIZE, PRESSURE RATING, SCHEDULE, CAPACITY, ETC AS APPLICABLE) IN THE LAST 7 YEARS IN OIL & GAS APPLICATIONS (EXCEPT FOR ITEMS MEANT FOR FIRE WATER SERVICE). IN SUCH CASES THE BIDDER SHALL PROVIDE SUPPLY RECORDS VIZ. COPY OF PO, INSPECTION REPORTS, INSPECTION RELEASE NOTE, PROVEN TRACK RECORD, EXPERIENCE DETAILS OR ANY OTHER DOCUMENTARY EVIDENCE TO ESTABLISH PAST SUPPLY, FOR OWNER'S REVIEW AND APPROVAL, AS APPLICABLE. THE ACCEPTANCE OF THE SAME IS AT THE DISCRETION OF THE OWNER AND SHALL REQUIRE APPROVAL OF PIPELINES HEAD OFFICE, Hyderabad.
2. AT THE TIME OF P.O. PLACEMENT, PROPOSED VENDORS SUPPLIER SHALL NOT BE IN HOLIDAY LIST OF GAIL/ BGL.

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

SCOPE OF WORK (ELECTRICAL SYSTEM)

TABLE OF CONTENT

SI No.	Description	Document No./ Drawing No.	Rev. No.	Pages
SCOPE OF WORK,				
1	Scope of Work			
3	Electrical Check List			
4	List of Suppliers of Major Bought-Out Items- Electrical			
QAP (Quality Assurance Planning)				
5	Quality Assurance Plan			
STANDARD DATA SHEETS				
6	UNINTERRUPTED POWER SUPPLY (UPS)			
7	LV SMALL POWER DISTRIBUTION BOARD			
STANDARD SPECIFICATION				
STANDARD DRAWINGS				
TENDER DRAWINGS				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**ELECTRICAL SCOPE OF WORKS FOR
CONSTRUCTION OF CNG STATION AT RETAIL OUTLETS (ON-LINE / DBS / MOTHER
STATION / DCU/ ETC,)**



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Sl. No.	Description	Page
1	General.	
2	Scope	
3	Other Miscellaneous Work	
4	Area Classification.	
5	Job Specification.	
6	Statutory approval of works.	
7	Makes of equipments and materials.	
8	Inspection, testing and commissioning.	
9	Drawings, standard specifications and Installation standards.	

1.0 GENERAL



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.1 Introduction

The intent of this specification is to define the requirements for the supply of equipment and materials (as required), erection, testing and commissioning of the electrical power distribution system e.g PDB, cable & UPS etc.

The work shall be carried out in the best workmanship – like manner, in conformity with these specifications, approved drawings and the instructions of the Engineer-in-charge from time to time.

The contract shall include clearing of temporary construction, waste materials and loose earth, which might get collected in and nearby the work site consequent of the execution of work under this contract.

1.2 Standards

The work shall be performed in conformity with, standard specifications and installation standards enclosed and code of practices of the Bureau of India Standards. In case of any conflict, the stipulations under this specification shall govern.

In addition, the work shall also conform to the requirements of the following: The Indian Electricity Act, and the rules framed there under

The fire Insurance Regulations

The regulations laid down by the Chief Electrical Inspector of the state government / Central Electricity Authority (CEA).

The regulations laid down by the Factory Inspector.

The regulations laid down by the Chief Inspector of Explosives.

Any other regulations laid down by the Central, State or Local Authorities from time to time during the pendency of this contract.

1.3 Guarantee


The contractor shall guarantee the installation against any defects of workmanship and materials (supplied by the contractor) for a period of 12 months from the date of issue of the completion certificate. Any damage or defects connected with the erection of materials, equipments or fittings supplied by the contractor that may be undiscovered at the time of issue of the completion certificate, or may arise or come to light thereafter, shall be rectified or replaced by the contractor at his own expense as deemed necessary and as per the instruction of the Engineer-in-charge within the time limit specified by the Engineer-in-charge.

The above guarantee shall be applicable for the quality of work executed as well as for the equipment / cable / fittings/ other material supplied by the contractor.

1.4 Site Conditions

The equipment offered and the installation shall be suitable for continuous operation under the following site conditions.

Max. / Min temperature	:	500C/50C Max.
relative humidity	:	90 %

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Altitude : Less than 1000 m above MSL
 Atmosphere : To withstand site conditions
 (Dry, dust storms during summer, Humid & Heavy
 Rainfall during Monsoon)

1.5 Power Supply Parameters :

i) For CNG MOTHER station & Other Equivalent Stations.

NORMAL POWER	415V AC, 3 Phase & Neutral
LIGHTING DISTRIBUTION (Normal)	230 V AC, 1 Phase
INSTRUMENTATION (UPS)	230 V AC, 1 Phase

2.0 SCOPE

2.1 SCOPE OF DESIGN & ENGINEERING

2.1.1 Submission of electrical equipment drawings for review/acceptance, preparation of site engineering drawings and details for installation works wherever applicable or required by the Engineer-in-charge, and submits to the Engineer-in-charge for review/acceptance.

2.1.2 Correction, updating and submission of all Owner's drawings for as-built status.

2.1.3 Obtaining clearance for energizing the complete electrical facilities covered under this tender and approval of installation and drawings from the Chief Electrical Inspector of the State Government/Central Electricity Authority and other statutory authority as required. This includes equipments installed or commissioned by others within the battery limit. This is for the purpose of obtaining a comprehensive approval in one go.

2.2 SCOPE OF SUPPLY


Following electrical equipment and material are in the contractor's scope of supply in this tender.

2.2.1 LV/MV power and control cable (XLPE – insulated armoured Al/Cu conductor 1/2/3/3.5/4 core cables).


2.2.3 GI pipes, GI Cable-trays and accessories, cable markers, identifier tags, GI saddles and all other associated accessories for cable-laying.

2.2.4 FLP type double-compression nickel-plated brass cable glands, tinned- copper lugs, clamping material etc. for cable termination.

2.2.5 Supply of lighting system, including lighting fixtures, switches, sockets, PVC conduit to be laid in the concrete slab / other civil construction etc. in safe area. Piano reed type sockets complete with MDF Board & 10 pair cable etc. for indoor Telephones including LAN wiring etc.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- 2.2.6 Earthing and lightning system, including earthing pits, earth electrodes, earthing strips, grounding conductor of various sizes, Cu strip for flange jumper and Cu earth plates etc.
- 2.2.7 Safety equipment in the stations/terminals, like shock treatment charts, caution boards, first aid equipment, rubber mats, portable fire extinguishers, sand bucket etc.
- 2.2.8 Split Air Conditioners with stabilizer(If required).
- 2.2.9 Inverter for emergency power approx 1100VA(If required).
- 2.2.12 Cables between transformer LT terminals of transformer & load break fuse switch unit, cable supports, double compression cable glands, lugs etc. as required.
- 2.2.13 Supply of 250 A TPN, AC-23 duty fuse switch unit in outdoor type dust & weather proof steel enclosure.
- 2.2.14 Supply of PDB(LT Panel) of suitable rating for indoor type along with type tested by CPRI etc(By Govt agency).
- 2.2.15 Supply of UPS(Uninterrupted Power Supply) as per contract/tender specification.
- 2.2.16 Supply of Earthing System(Earthing Pit, G.I Strip, Earthing system including box for LCV) as per SOR.
- 2.2.17 Fabrication and supply of MS frames, supports, canopies and brackets for miscellaneous electrical equipments, including welding, supply of bolts, nuts etc for mounting and other necessary supplies, all inclusive of painting as specified.
- 2.2.18 Supply of Outdoor lighting fixture including pole etc as required.
- 2.3 SCOPE OF INSTALLATION, TESTING & COMMISSIONING
- 2.3.1 Laying & termination of all LV/MV power and control cables laid in concrete-lined trenches, buried cable trenches, pipes, road crossings, pipe-racks etc.
- 2.3.2 Installation testing & commissioning of 415 V switch boards/PDBs/LDBs.
- 2.3.3 Installation, testing & commissioning of Cables between transformer LT terminals of transformer & load break fuse switch unit, cable supports, double compression cable glands, lugs etc as required.
- 2.3.4 Installation, testing & commissioning of 250A/125A TPN, AC-23 duty MCCB for outdoor type dust & weather proof steel enclosure.
- 2.3.5 Installation, testing & commissioning of UPS System.
- 2.3.6 Installation, testing and commissioning of lighting system in buildings.
- 2.3.7 Installation, testing and commissioning of street Lighting System/Outdoor Lighting system.

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

2.2.19 Installation, testing and commissioning of Earthing System(Earthing Pit, G.I Strip, Earthing system including box for LCV) material including lightning protection system as per SOR.

2.3.8 Installation, testing and commissioning of the contractor supplied materials.

2.3.9 Installation testing & commissioning of Inverter for emergency power.

2.3.10 All works relating to statutory approvals of the complete installation, from competent authority like CEA, DGMS, State electricity authority/Board etc, shall be in the scope of contractor.

3.0 OTHER MISCELLANEOUS WORKS

3.1 Preparation of buried cable trenches, including, back filling, compacting providing of brick protection by second-class bricks, spreading of fine river sand, including all supplies.

3.2 The job includes repairing of all civil works damaged during installation of electrical facilities.

3.3 The scope of work under this contract shall be inclusive of breaking of walls, floors and chipping of concrete foundations necessary for the installation of equipment, materials, and making good of the same.

3.4 Minor modifications wherever required to be done in the owner free supplied equipments / devices to enable cable entry, termination, etc.

3.5 Sealing of opening made in the walls / floors for cables trays, cables, bus ducts, etc using acceptable practice and standards.


3.6 Supply and installation of all other accessories not specifically mentioned herein, but never the less necessary for completion of the job.

4.0 AREA CLASSIFICATION

Hydrocarbon handling areas have been generally classified as zone 1, gas group IIA/IIB as per IS: 5572, API RP-500, OISD - 113 and IP Rules. All equipments to be installed in these areas shall be suitable for the area classification with temperature class T3 (2000C), CMRI testing and approved by CCOE, DGFAS and having BIS license.

5.0 JOB SPECIFICAITONS

Various electrical works covered under this contract like equipment erection, cabling, lighting and grounding works, etc. shall be performed in accordance with specifications attached with this tender. (Certain clauses of specifications, which are applicable to equipments or system not covered under this contract, shall not be applicable).

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Erection and commissioning of certain special equipments shall be performed in accordance with supplier's instructions and directions of the Engineer-in-charges under supervision by equipment supplier/s.

The equipments/materials to be supplied by the contractor shall conform to the requirements of the applicable specifications enclosed in the tender document.

6.0 STATUTORY APPROVAL OF WORKS

All works relating to statutory approvals of the complete installation, from competent authority like CEA, DGMS, State electricity Authority/Board etc, shall be in the scope of contractor.


The application on behalf of the owner for submission to Electrical Inspector / DGMS etc. along with copies of required certificates and drawings, complete in all respects, shall be prepared by the contractor and submitted to the Engineer-in-charge for onward transmission well ahead of time so that the actual commissioning of equipment are not delayed for want of inspection by the Electrical Inspector / DGMS. The actual Liaison work shall be arranged by the Contractor and necessary coordination and liaisons work in this respect shall be responsibility of the contractors. However, the Owner on submission of bills along with documentary evidence shall reimburse any fee paid to the statutory Authority in this regards.

7.0 MAKES OF EQUIPMENTS AND MATERIALS

All equipments / materials supplied by the contractor shall be as per the list of approved makes enclosed with this document subject to submission of Certification and approvals.

8.0 INSPECTION, TESTING & COMMISSIONING

- a. All the equipment supplied and installed by the contractor shall be tested and commissioning as required and no separate payments shall be made. Contractor shall purposes. Any damage or defect noticed shall be brought to the notice of the engineer-in-charge.
- b. Any work not conforming to the execution drawings, specifications or codes shall be rejected forthwith and the contractor shall carry out the rectification at his own cost.
- c. The contractor shall carry out all the tests as enumerated in the technical specifications and as per applicable codes and standards.
- d. Before the electrical system is made live, the electrical contractor shall carry out suitable tests to establish to the satisfaction of engineer-in-charge that the installation of equipments, wiring and connections have been correctly done and are in good working condition and that it will operate as intended.
- e. All the tests shall be conducted in the presence of Owner/ Engineer-in/charge or his authorized representative unless he waives this requirement in writing. The contractor

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

shall arrange all testing equipment necessary to carry out the test. The tests shall be recorded on approved Performa and certified records of the tests shall be submitted to Owner/ Engineer-in-charge.

- f. After the completion of all tests and rectification of all defects pointed out during final inspection, plant start-up trials would be commenced. During the start-up trials contractor shall provide skilled / unskilled personnel and supervision round the clock at his cost. The number and category of workmen and duration up to which required, will be decided by the Engineer-in-charge. Any defects noticed during the start-up trial relating to the equipment supplied and work carried out by the Contractor, will be rectified by the contractor at his own cost.
- g. Engineer-in- charge shall have the right to get these defects rectified at the risk and cost of the contractor if he fails to attend to these defects immediately as desired.
- h. After the operating conditions are fully achieved in the plant and the other requirements as stated in the General Conditions of Contract are fulfilled, the contractor would be eligible for applying for a completion certificate.

9.0 DRAWINGS, STANDARD SPECIFICATIONS AND INSTALLATION STANDARDS

- 9.1 The equipments / materials to be supplied by the contractor shall conform to the requirements of the applicable specifications. Also the installation of various material / equipment shall conform to the installation standards /norms.
- 9.2 The drawings accompanying the tender documents when read with specification shall depict the electrical system of the Terminal. These are indicative of the nature of work and issued for tendering purposes only. Purpose of these drawings is to enable the tendered to make an offer in line with the requirements of the Owner. Construction shall be as per drawings / specifications issued / approved by the Engineer-in-charge during the course of execution of work.
- 9.3 Conduit layout drawing in ceiling, wherever required, to be prepared by the contractor and shall be submitted for approval.
- 9.4 After the job completion, contractor shall prepare AS-BUILT drawings and documents, submit catalogues/manuals (O&M) of major brought out items like UPS, Inverter, HT Substation, Lighting fixture etc. Final certified as built drawings, documents and manuals etc shall be submitted by the contractor to owner in bound volume with one set in soft copy (CD) plus five sets of prints.

ANNEXURE-A

LIST OF TOOLS KITS AND INSTRUMENTS (ONE SET PER FIVE NOS. STATIONS)

S. No.	ELECTRICAL INSTRUMENTS	Qty.
1	500 V Hand Driven Insulation Resistance tester (Make-Fluke, Megger, Motwane)	01 No.
2	Earth Tester Kit, complete with electrodes and connector (Make-Fluke, Megger, Motwane)	01 No.
3	Digital Tong Tester for A.C. & D.C. current measurement (Make-Rishabh, Fluke, Matwane)	01 Nos.
4	Digital Multimeter (Make-Rishabh, Fluke, Motwane)	01Nos.
4	Hand Drill Machine (Make-Bosch)	01 No.
5	Fuse Puller	01Nos.
6	Manual Crimping Tool with accessories for cable size up to 185 mm ²	01 No.

One no. of tool box to be provided at each control room building. Tool box should contain at least the following tools.

- A) Slides wrench -2 Nos. (12" & 8")
- B) Ring Spanner-1Set
- C) DE Spanner-1Set
- D) Pipe wrench-1Set (14")
- E) Screw Driver-1Set
- F) Electrician screw driver-1 Set
- G) Millimeter -1No
- H) Allen Key - 1Set
- I) Drilling machine (1000 Watt) with multipurpose toolkit-1Set
- J) Industrial Electric Extension Board. (Make-Anchor or equivalent) -1 No.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

TO BE FILLED-UP BY TENDERER

Sl. No.	Description	Remarks
1.	No deviation from the Electrical Specification/ SOR	
2.	Filled up Annexure-IIA, IIB & IV of document no. (Data Sheet)	
3.	Un priced schedule of rate (SOR) enclosed.	
4.	List of similar electrical job undertaken during last three years has been enclosed with the offer.	
5.	List of electrical personnel employed, with their qualification & experience, has been enclosed with the offer.	
6.	Credential of electrical sub- contractor, enclosed with the offer.	
7.	Photocopy of Electrical Contractor's license – grade A has been enclosed with the offer.	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**ELECTRICAL
LIST OF SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS**

Air Conditioner

1. O General
2. Daikin
3. Hitachi

Batteries (Lead Acid)

1. Exide Industries Ltd.
2. HBLNIFE Power System Ltd.
3. Amara Raja Batteries Ltd.

Batteries (Nickel Cadmium)

1. Amco Batteries Ltd.
2. HBLNIFE Power Systems Ltd.

Batteries Charger/DC-DC Converter

1. Amara Raja Power System(P)Ltd.
2. BCH.
3. Chhabi Electricals Pvt. Ltd.
4. Caldye Automatics Limited
5. Dubas
6. HBL Nife Power Systems Ltd.
7. Universal Industries Products
8. Universal Instrument Mfg Co Pvt Ltd

Cable – Fire Alarm & Communication Cables

1. Cords Cable Industries Ltd.
2. CMI
3. Delton cables Ltd.
4. ELKAY Telelinks
5. KEI Industries Ltd.
6. Reliance Engineers Ltd.

Cable – HT(XLPE)

1. Universal Cable Ltd.
2. KEI Industries Ltd.
3. Industrial Cables
4. NICCO Corporation Ltd.
5. Uniflex
6. Polycab.
7. Torrent cables Ltd.

**ELECTRICAL
LIST OF SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS**

Cable – LT Power (XLPE)

1. Universal Cable Ltd.
2. Polycab wires Pvt Ltd, Mumbai
3. Industrial cables (I) Ltd
4. Cable corporation of India Ltd, Mumbai
5. Gloster cables Ltd
6. Nicco Corporation Ltd, Kolkata
7. Torrent Cables Ltd
8. RPG Cables Ltd
9. Uniflex cable Ltd
10. KEI Industries Ltd.
11. Havells.
12. Crystal cables Industries Ltd
13. Finolex

CONTROL & Signal Cables

1. Cords Cable Industries Ltd
2. Universal Cable Ltd
3. Sriram Cables Ltd
4. KEI Industries Ltd
5. Shyam Cable Industries
6. Havells India Ltd
7. Deltron Cables Ltd
8. Thermo Cables Ltd
9. Elkay Telilinks Ltd
10. Ajanta electrical Industries
11. AP Industries
12. Udey Pyrocable Pvt Ltd
13. Finolex Cables Ltd
14. Gemscab Industries Ltd
15. Rallison Electricals Pvt Ltd
16. Suyog Electricals Ltd
17. Gupta Power infrastructure Ltd
18. Torrent Cables Ltd
19. SCOTT Innovation Wires and cables
20. Diamond Power Infrastructure
21. North eastern cables Pvt Ltd
22. KEC International Ltd
23. Assian Galaxy Pvt Ltd
24. Cabtech cable industries
25. Insucon Cables
26. Suraj Cables
27. Windsor Cables Pvt Ltd
28. Polycab



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Signal Cables

Cords Cable Industries Ltd

1. Universal Cable Ltd
2. Sriram Cables Ltd
3. KEI Industries Ltd
4. Shyam Cable Industries
5. Thermo Cables Ltd
6. Elkay Telilinks Ltd
7. Ajanta electrical Industries
8. AP Industries
9. Udey Pyrocable Pvt Ltd
10. Gupta Power infrastructure Ltd
11. Insucon Cables & Cond Pvt Ltd
12. Ravin Cables
13. Ravi Industries
14. Suyog Electricals Ltd
15. Associated Cables Ltd
16. Polycab Ltd

Cable – Gland

1. Baliga
2. Comet
3. Flexpro
4. Flameproof
5. FCG
6. Standard Metal Industries
7. Sudhir Switchgear Pvt Ltd
8. Kayao Techno Equipment Ltd

Cable – Lugs

1. Dowels
2. Punitam
3. Varuna Controls & Infrastructure
4. Rapid Manufacturing CO

Cable – Tray

1. Mem
2. Bharati
3. Ratan
4. Slotco
5. Profab

Cable Termination and Jointing Kit

1. Cci
2. Raychem
3. M-Seal

Ceiling/Exhaust/Pedestal Fans & Circulators

1. Bajaj Electricals Ltd.
2. Crompton Greaves Ltd.

3. Khaitan Electricals Ltd.
4. Havell's Contractors –

AC Power

1. BCH
2. ABB
3. GE
4. L&T
5. Schneider
6. Siemens Ltd.
7. Telemecanique

Control Transformer

1. Logicstat
2. G & M
3. Indcoil
4. Precise

DG Set

1. Sterling and Wilson.
2. GD ankalesaria.
3. Deev Genset.
4. Jackson
5. Sudheer Gensets.
6. Power Engineering(India) Pvt Ltd.

Earthing Materials

1. Rukmani Electrical & Components Pvt Ltd.
2. Indiana Grating Pvt Ltd.
3. Jef Techno Solutions Pvt Ltd

Flame proof LDB's/ JB,s/Control Station/ switches

1. FCG
2. Sudhir Switchgear Pvt Ltd
3. Prompt Engineering Works
4. Flame Proof equipments pvt. Ltd.
5. Baliga Lighting Equipments Pvt. Ltd.
6. Flexpro Electricals Pvt. Ltd.

High Mast

1. Bajaj Electricals Limited
2. Crompton Greaves Limited.
3. Philips India Limited
4. Surya Roshani

High Voltage PCC/ MCC panels

1. BHEL
2. Control and Switchgear



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3. Siemens
4. Tricolite Electrical Industries
5. Schneider
6. CGL
7. L&T

Indicating Lamps

1. ABB
2. BCH
3. L&T Ltd.
4. Siemens Ltd.
5. Tecknic
6. Schnieder

Indicating Meters

1. ABB
2. AMCO
3. AE
4. Alstom Ltd. (EE)
5. Conzerv/Schneider
6. Elecon Measurement Pvt. Ltd.
7. HPL Electric & Power Pvt. Ltd.
8. MECO Instruments Ltd.
9. Minilec
10. Rishabh Instruments Pvt. Ltd.
11. Trinity energy system
12. kaycee
13. Salzer

Lighting Fixtures (Flameproof)

1. Baliga Lighting Equipment Pvt Ltd.
2. Flameproof Equipments Pvt Ltd
3. Flexpro Electricals Pvt. Ltd.
4. FGG
5. Sudhir Switchgear Pvt Ltd
6. Flameproof Control gears Pvt Ltd
7. Ex Protecta

Miniature Circuit Breakers (MCBs) and Lighting DB

1. ABB
2. Hagger
3. Havell's India Ltd.
4. Indo Asian Fusegear Ltd.
5. Legrand
6. MDS Loadstar
7. Schneider
8. L & T

Moulded Case Circuit Breaker (MCCBs)

1. ABB
2. GE Power
3. Larsen & Toubro
4. Schneider
5. Siemens

Indicating Meters

1. L & T
2. AE
3. Conzerv
4. HPL Electric Power Pvt Ltd
5. Mecos Industries Ltd
6. Rishabh Instruments Pvt Ltd
7. Secure Meters
8. Schneider

Protection Relays – Thermal

1. L&T Ltd.
2. Siemens Ltd.
3. GE
4. ABB
5. Schneider

Low Voltage Power Control Center (PCC)/ MCC/ PDB/ MLDB/ LDB

1. ABB
2. BCH
3. C & S
4. Elecmech Switchgear & Instrumentation
5. KMG ATOZ
6. L&T
7. Pyrotech Electronics Pvt. Ltd.
8. Risha control Engineers Pvt. Ltd.
9. Siemens
10. Tricolite Electrical Industries
11. Unilec Engineers Ltd.
12. Vidyut Control India Pvt. Ltd.
13. Control and Schematic
14. Zenith Engineering
15. Skytech House
16. Mundra Electricals Pvt. Ltd.

Push Buttons

1. BCH
2. ABB
3. L&T
4. Siemens Ltd.
5. Telemenchanique & Controls (India) Ltd.
6. Schneider

Switches-Control

1. L & T
2. Siemens
3. GE Power
4. Schnieder
5. ABB
6. Havells
7. Legrand

Switches – 5/15A Piano/ Plate, Switch Socket

1. Anchor Electronics & Electricals Pvt. Ltd.
2. L & T
3. Siemens
4. GE Power
5. Schnieder
6. ABB
7. Havells
8. Legrand

Switch Socket Outlets (Industrial)

1. Anchor
2. Havells
3. Legrand
4. ABB

Solar Modules

1. Tata BP Solar (I) Ltd.
2. REIL, Jaipur.
3. CEIL, Sahibabad.
4. HBL Power

Solar Street Lighting

1. Tata BP Solar (I) Ltd.
2. REIL, Jaipur.
3. CEIL, Sahibabad.
4. HBL.

Terminals Blocks

1. Connectwell
2. Controls & Switchgear Co. Ltd.
3. Elmex Controls Pvt. Ltd.
4. Essen Engineering Co. Pvt. Ltd.

Fuse

1. L & T
2. Siemens



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3. GE Power
4. Cooper Bussman
5. Schnieder

Transformers

1. ABB
2. Andrew Yule
3. Areva
4. BHEL
5. Bharat Bijlee
6. Crompton Greaves
7. EMCO Ltd.
8. Intra Vidyut
9. Indushree
10. Indcoil
11. Kirloskar
12. Skippers Electricals
13. Transformers & Rectifiers (I) Ltd.
14. Voltamp

UPS System and Inverter

1. DB Power
2. Aplab
3. KELTRON
4. Hitachi HI-REL
5. Gutor Electronical Ltd
6. AMETEK
7. Chloride
8. Toshiba Corporation
9. Synergy Systems
10. DUBAS Engineering Pvt Ltd
11. Borri S P A
12. Emerson
13. Best Power Equipment Pvt. Ltd.


Batteries

1. NED Energy Ltd
2. HBL Power System Ltd
3. Exide
4. Amar Raja

Change Over Switch

1. MSD
2. Indoasian
3. Crompton Graves
4. CGM
5. L & T

GI-Octogonal Pole

 <p>Bhagyanagar Gas Limited</p>	<p align="center">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p align="center">VOLUME II OF II</p>
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1. Bajaj
2. Transrail
3. Wipro

NOTE:- Item/Vendor, which are not listed above, shall be subject to prior approval from Client/Consultant.

Note:


1. Apart from the vendors detailed in the above list or items with no Vendor list, the contractor may propose any other vendor having Credentials for supply of respective items (for the same or higher Size, schedule, capacity, etc as applicable) in the Last 7 years in Oil & Gas applications. In such cases the bidder shall provide supply records viz. Copy of P.O, inspection reports, inspection release note, proven track record, experience details or any other documentary evidence to establish past supply, for owner's review and approval, as applicable. The acceptance of the same is at the discretion of the Owner and shall require approval of head office, Hyderabad.
2. At the time of P.O placement, proposed vendors supplier shall not be in holiday list of BGL/GAIL



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

QUALITY ASSURANCE PLAN (ELECTRICAL)

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

QUALITY ASSURANCE PLAN (ELECTRICAL)



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	CONTRACTOR		ELECTRICAL EQUIPMENT	CLIENT:	CLIENT
	ORDER NO. & DATE			PROJECT:	CNG & CGD PROJECT
	SUB-CONTRACTOR			PACKAGE NO.	
	ORDER NO. & DATE			PACKAGE NAME	Electrical System

INSTRUCTIONS FOR FILLING UP :

- QAP shall be submitted for each of the equipment separately with break up of assembly/sub-assembly & part/component or
- Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment
- Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together.

CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS:

Code Description Code Description Code Description DOCUMENTS:

- Visual 12. Routine test as per relevant IS 23. Short time rating D1. Approved GA drawings



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

4. Weight in tonnes (T) must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available.

2. Dimensional other standard 24. Operational & functional D2. Approved single line/
3. Fitment & Alignment 13. Type test as per relevant IS/ check schematic diagram
4. Physical Test (Sample) other standard 25. Over Speed Test D3. Approved
5. Chemical Test (Sample) 14. Impulse Test 26. Flame Proof Test data sheet
6. Ultrasonic Test 15. Partial Discharge Test 27. Clearance and creepage D4. Approved bill of materials
7. Magnetic Particle Test (MPT) 16. Heat run risc test\tempr. Distance D5. Unpriced P.O. copy
8. Radiography Test 17. Enclosure Protection Test 28. Acceptance Test D6. Calibration Certificate
9. Dye Penetration Test 18. Calibration 29. Harmonics measurement . of all measuring
10. Measurement of IR Value 19. Noise & Vibration instruments and gauges
 - a) Before HV Test 20. Test certificates for bought out
 - b) After HV Test components
11. High Voltage test/Dielectric 21. Tank Pressure Test test 22. Paint shade verification

ABBREVIATIONS USED :
CONTR : CONTRACTOR
MFR : MANUFACTURER



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

EQUIPMENT DETAILS							INSPECTION TESTS						Test Certificate s & documents to be submitted to PMC	Acceptance Criteria Standards /IS/ BS/AS ME/ Norms and Documents	REMARKS / SAMPLING PLAN
Sl. No.	Description (With equipment heading, place of use, and Brief Specifications)	Identification No.	Quantity		Manufacturer's Name and Address	Expected schedule of Final Inspection	Raw Material and inprocess stage inspection			Final Inspection/Test by					
			No/M	T			MFR	CO NTR	P M C	MFR	CO NTR/ TPI	PMC			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Power & Lighting Distribution Board		Set				1, 2,3,4	-	-	1,2,3,12,	1,2,3,12,	1,2,3,12,	D1, D2, D3, D4,	I.S., Data Sheet, Specification, Approved	13* for similar rating



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

						24, 27			22, 24, 27	22, 24, 27	22, 24, 27	D5, D6, 20, 12, 13*, 16	Drawings	
2	LT Power and Control Cable		Mt.			-	-	-	1, 0, 11,	1, 2, 10, 1, 1,	1, 2, 1, 0, 11,	28, 12, 13,	I.S., Data Sheet, Specifications & Test Certificate	13* for similar rating, Inspection to be done by TPI
4	UPS System		Set			1, 2, 3, 4,	-	-	1, 2, 3, 1, 2,	1, 2, 3, 1, 2,	1, 2, 3, 1, 1,	D1, D2, D3, D4,	I.S., Data Sheet, Specification, Approved Drawings	16* Heat Run test upto temp stability.
						24, 27			22, 24, 27	22, 24, 27	12, 16, 22, 24, 27	D5, D6, 20, 12, 13*, 16		



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

For
Manufacturer

(Stamp &
Signature)

For
CONTR

(Stamp
&
Signature)

For
PMC

(Stamp
&
Signature)

Q.A.P. NO.

SHEET
1 OF 1 R-0



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

STANDARD DATASHEETS (ELECTRICAL SYSTEM)



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

LIST OF DATA SHEETS/ANNEXURES (ELECTRICAL)

Sl. No.	Description of Data Sheets	Data Sheet No.
1	LV SMALL POWER DISTRIBUTION BOARD	
2	DISTRIBUTION TRANSFORMER	
3	UPS	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**DATA SHEET FOR
UN-INTERRUPTED POWER SUPPLY (UPS) SYSTEM**

SPECIFICATION NO.-/DS/05/E9/071



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

ANNEXURE - I

PURCHASER'S DATA FOR UPS

1.0 INPUT POWER SUPPLY

1.1	Voltage/freq./ phase	415 V (+) 10% & (-) 15% TPN, 50 Hz \pm 5% or 230V
		AC single phase (voltage range-To be provided by Bidder) As per SOR.
1.2	System fault level	10 kA for 1 Sec

2.0 SITE CONDITION

2.1	Design Maximum /Minimum temperature	48°C/2°C
2.2	Max. Relative humidity	95%
2.3	Altitude	Below 1000.0 M MSL

3.0 OUT PUT REQUIREMENT

3.1	Voltage/ Phase	230V \pm 1% AC, Single phase 2 wire
3.2	Output waveform & frequency	Pure Sinusoidal Wave 50 Hz \pm 0.1%
		Voltage distortion (THD): Less than 3% for linear loads & Less than 5% for non linear loads.

4.0 SYSTEM REQUIREMENTS

4.1	Rating KVA	As per SOR
4.2	Type of inverter	The inverter circuit should be IGBT based, fully microprocessor controlled with PWM Technology or Latest proven technology
4.3	Overload capacity	125% of the rated output for 10 minutes & 150% for 1 minute.
4.4	Mode of operation	Dual/Parallel Redundant with static bypass & Dual Redundant rectifier as specified in SOR/Design basis/Block diagram
4.5	Inverter efficiency	>90% for normal load and not below 85% for 25% of load
4.6	Installation	Floor Mounted
4.7	Type of enclosure	Minimum IP-31
4.8	External Cable Connection	From Bottom
4.9	Internal protection	All live parts shrouded



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

4.1	Earthing	Doubly Earthed (Two distinct terminals to be made available)
4.11	Cooling	Forced ventilation with fans
4.12	Noise Level	<65 dB at full Load from 1 mtr distance
4.13	Crest Factor	≥3:1
4.14	Input Power Factor	>0.9
4.15	Load Power Factor	with variation between 0.6 to 1.0
4.16	UPS Line Power factor	>0.8
4.17	Overall efficiency	>85%
4.18	Harmonics	As per IEEE 519 (Total demand distortion not more than 5.0%)
5.0 Rectifier/Charger		
5.1	Input voltage	415 V (+) 10% & (-) 15%, TPN, 50 Hz ± 5% or 230V AC single phase (voltage range-160V AC to 270V AC) or 230V ± 1% AC from UPS (As per SOR).
5.2	Automatic phase selection device	As per SOR
5.3	Output DC voltage/Load	As per Manufacturer Design
5.4	Input Power factor	>0.8 (minimum) at rated load
5.5	Input current THD (Total Harmonic Distortion) at nominal load	
5.6	Overload Capability	125% minimum for 15 min. 150% minimum for 1 min.
5.7	Inrush current	Limited by soft-start circuit
5.8	Output voltage tolerance	+/- 1%
5.9	DC voltage ripple	<1% with battery connected <2 % Without battery connected
5.1	Rectifier	IGBT Based
5.11	Filter	Input side line filter
5.12	Harmonics	As Per IEEE-519 (Voltage THD<5%, largest single voltage harmonics<3%, Total demand distortion <5%
5.13	Charging	Automatic Float and Boost charging (selection as per battery charging state(voltage level))

6.0 Bypass



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

6.1	Automatic Bypass	Static bypass to provide an un interruptible transfer of load in case of failure of any system component or malfunctioning or overload & the load shall return on the UPS when the malfunctioning or overload is cleared.
6.2	Input connection	Separate for each UPS
6.3	The switching time from inverter to bypass & vice versa	No break type
6.4	Manual/Maintenance Bypass	Shall be provided
6.5	Overload on bypass	150% (minimum) for 1 min., 125% (minimum) for 15 min.
6.6	Connectivity	Ethernet
7.0 Battery Bank		
7.1	Type of Battery	As per SOR
7.2	Battery Arrangement	2 X 50%
7.3	i) Battery end cell voltage	As per specification (clause no. 3.5) As per battery manufacturer
	ii) Battery stand formation	As per SOR
	iii) Battery back up time	(i) Ageing -- 0.8
		(ii) State of Charge -- 0.88
		(iii) Temp. Correction -- As per min. site temp. (Ref. 2.1 above)
		The rectifier/charger output current & voltage shall be limited to the battery supplier's recommendation.
8.0 Alarms, Indications and LCD Display		
8.1	Single line Power Flow Diagram (Mimic diagram) with LED indications of UPS status (i.e. Mains present, Battery charging & discharging, Low battery Voltage and unit on bypass).	
8.2	Digital panel Meter with LCD display shall be provided for monitoring viz.	a) Input AC Voltage, current, frequency
		b) Output AC Voltage, current, frequency.
		c) Battery current and voltage
		d) Total run time
		e) Mains ON/OFF, Mains Over/Under voltage,
		Phase fail



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

		<p>f) Inverter ON/OFF, Inverter Over/Under voltage, inverter overload, over heat & load in % on inverter.</p> <p>g) Battery voltage low, battery level in % & battery fault</p> <p>h) Battery Operation Boost Charge, Float Charge with of status - "in charge" or "discharge"</p> <p>i) Load on bypass or inverter.</p> <p>Detailed UPS Status with Operation/faults history</p>
8.3	Audible Alarms With LCD Display-	<p>a) Mains Failure</p> <p>b) Battery Low</p> <p>c) UPS fault (Continuous)</p> <p>d) Inverter Under-voltage</p> <p>e) Over Temperature (Continuous)</p> <p>f) Inverter Overload (Continuous)</p>
9.0 Protective Features		
9.1	Input	Mains Over voltage, under voltage, phase failure
9.2	Inverter	Over voltage, short circuit, overload, over temperature
9.3	Battery	Under voltage at battery terminal, Battery over charge, Battery Over current
9.4	Rectifier & Battery charger	<p>Maximum current limiting Over temp. Trip</p> <p>Boost charging and float charging current limiting</p> <p>with back up protection against over charging.</p>
10.0 Distribution boxes		
10.1	Distribution Board Details	<p>(As per tender drawings/SOR)</p> <p><u>(1) ACDB 230 V, Single Phase (1 No.) :</u></p> <p>Incomer : DP MCB</p> <p>Outgoing : 3 Nos 50A (Combination) DP MCCB's and 32 A MCB DP-3 nos., 6 A DP 6 Nos.</p>
11	Battery monitoring System	Yes with communication
12	UPS communication	Ethernet



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

13	Selector switch	For Auto manual switch for Float and boost Selection
14	Toggle switch	Float and Boost selection

ANNEXURE-II (A)		
TECHNICAL DATA FROM MANUFACTURER		
(To be filled up by the Tendered)		
1.0	INVERTER	
1.1	Manufacturer's Model No. (Enclose catalogue)	
1.2	Rating (at specified ambient) / no. of phases	
1.3	Applicable codes/standards	
1.4	Steady state output volt/freq (230 V \pm 1%) (50 Hz \pm 0.1%)	
1.5	Input voltage - DC	
1.6	Synchronization (inv. phase locked with main) in percentage	
1.7	Synchronization manually adjustable in steps of	
1.8	Allowable unbalance between phases (for 3 Phases only)	
1.9	Harmonics distortion for linear & non-linear loads	
1.10	Mode of operation	Dual/Parallel Redundant with static bypass as specified in SOR/Design basis/Block diagram
1.11	Dynamic Responses at following conditions a) \pm 50% step load (for parallel redundant UPS) b) \pm 100% step load (for hot standby and single UPS system). c) Power supply interruption and restoration. d) Load Transferred to bypass line e) When one inv. gets faulty and load transferred to healthy inv. (for parallel redundant UPS)	
1.12	Recovery time to reach steady state after above disturbance (not more than 100m Sec)	
1.13	Overload capacity (125% minimum for 15 min. 150% minimum for 1 min.)	
1.14	Short circuit capacity and duration (in % and m sec.)	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.15	Noise Level (dB at 1 m) (Not more than 65 dB)	
1.16	Efficiency at 100%/75%/50% loads (not less than 90% at 100% load)	
1.17	Type of control circuit	
1.18	Out put voltage & phase angle (for 3 Phase only) a) For 30% unbalance load b) For 40% unbalance load c) For 50% unbalance load d) For 100% unbalance load	
1.19	Crest Factors	
2.0 STATIC SWITCHES		
2.1	Nos. of static switches in each set	
2.2	Current rating at specified ambient	
2.3	Transfer time (m sec.) a) Synchronized mode (not more than 4msec) b) Unsynchronized mode (not more than 20msec)	
3.0 BATTERY CHARGER		
3.1	Rating (Amp.) / MAKE (Enclose back up calculation).	
3.2	Type of charger (Basic configuration)	
3.3	Output volt under float/boost charging condition	
3.4	Volt. Accuracy under specified input ($\pm 1\%$)	
3.5	Max. Ripple content on DC side (% RMS) (not more than 2% without battery & 1% with battery connected)	
3.6	Efficiency at 100%/75%/50 % of load	
3.7	Mode of Change over from float to boost and vice- versa	
4.0 BATTERY		
4.1	Make	
4.2	Type (Enclose catalogue)	
4.3	AH rating (Enclose back up calculation)	
4.4	End cell voltage at specified discharge rate (V/ cell)	
4.5	Output (Nominal) volts	
4.6	No. of battery banks	
4.7	No. of cells in each bank	
4.8	Battery charging requirements (V/ cell)	
	a) Volts/Cell/Nominal	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	b) Float	
	c) Boost	
4.9	Voltage variation from fully charged battery to discharged battery (volts)	
4.1	Charging time (Hrs.)	
4.11	Max. Permissible ripple content (% RMS)	
4.12	Overall dimension (L*W*H)	
4.13	Container type	
4.14	Accessories for battery as per specification included	Cell testing Voltmeter, Pair of Gloves, Insulated Spanner, Extra Electrolyte, Hydrometer, Thermometer etc.
4.15	Type/Formation of battery stand	
5.0 MANUAL TRANSFER DEVICES		
5.1	Rating (Amp.)	
5.2	Make/Type	
6.0 STEP DOWN BYPASS TRANSFORMER WITH SOLID STATE VOLTAGE STABILISER		
6.1	Make/type	
6.2	Rating and Voltage ratio	
6.3	Accuracy of stabilizer (not more than $\pm 2\%$)	
6.4	Type of control (Solid state)	
6.5	Type of cooling	Natural
7.0 AC DISTRIBUTION BOARD		
7.1	Nos. of feeder/rating	
7.2	Cable entry from (Bottom)	
7.3	Max. Rating of outgoing feeders possible for fault clearance by UPS with and without supply back up (as percentage of UPS rating) not less than 25%.	
	a) With fast acting semi conducting fuses	
9	Indications and Alarm	
10	Metering	
11.0	UPS Dimension (L x W x H) except Battery (Including inverter, charger, rectifier, bypass stabilizer, ACDB etc.)	
12.0 OVERALL EFFICIENCY OF UPS SYSTEM		
12.1	Ratio of output load to input drawn from mains when inverters are on and synchronized with bypass. a) At 100% load b) At 75% load c) At 50% load	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

13.0	RELIABILITY a) Safety factor used for selecting electronic components/ other electrical components (not less than 200%/125% respectively) b) MTBF / MTR c) Availability factor	
14.0	DEGREE OF PROTECTION OF THE PANEL (Minimum IP – 31)	
15.0	Heat loss for total system (W)	
16.0	Potential free contracts (for duplicating of fault status in remote panel).	
17.0	Fault status shall be compatible to hook-up with Owner's PC through Ethernet interface.	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

ANNEXURE- II (B)

TECHNICAL DATA FROM MANUFACTURER

1.0	2x100% RECTIFIER UNITS	
1.1	Mains Input	
	a) Voltage & Frequency	415 V (+) 10% & (-) 15%, TPN, 50 Hz \pm 5% or 230V AC single phase (voltage range-160V AC to 270V AC) or 230V \pm 1% AC from UPS. (Rectifier may be fed from UPS output. However it shall also be suitable for these variations if operated independent of UPS).
	b) Input harmonics (max.) at full load.	5% RMS (Voltage)
1.2	Out put details	
1.2.1	Rectifier	
	a) Voltage / Wattage	24 V DC , Watt as per SOR
		(-) 48 V DC, Watt as per SOR
	b) Method of Voltage /Current Control	
1.2.2	Load Bus	
	a) Voltage Regulation from Full load to no load (for mains variation of \pm 10%)	+ 5%
	b) Ripple Content (<30 mV)	
	c) Rating of Double pole MCB and fuses for DCDB	(DP MCB's with semiconductor fuses and DC bus for 4 outgoing feeders)
1.3	Efficiency of Rectifier (at 50%, 75%, 100% load)	
1.4	Power Factor of Rectifier (at all load)	0.6 to 0.7 (lag)
1.5	Annunciator details	
	a) Audio – Visual	DC over voltage Rectifier Failure Load C.B. Trip



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	b) Push buttons	Acknowledge, reset
	c) Remote	One no. potential free common alarm annunciation contact.
1.6	Indication Lamps	AC Power ON, Rectifier ON
1.7	Meters	A.C. input ammeter and voltmeter. Output ammeter and voltmeter.
1.8	MTBF (Hrs.)	60,000 Hrs.
1.9	MTTR (Hrs.)	4 Hrs. (Approx.)
1.10	PTRV (Peak Transient reverse voltage)	600 V on AC side 200 V on DC side
1.11	Construction Details	
	a) Type of Cooling	Natural
	b) Cable entry	Same as UPS Panel
	c) Access	Same as UPS Panel
	d) Painting	Same as UPS Panel
	e) Degree of Protection	Same as UPS Panel
1.12	Safety Factor	2



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

ANNEXURE – III

PREFERRED MAKES

UPS System and Inverter


1. EMERSON
2. DB POWER
3. NUMAX
4. KELTRON
5. HI-REL

Batteries (Lead Acid)

1. Exide Industries Ltd.
2. HBLNIFE Power System Ltd.
3. Amara Raja Batteries Ltd.

Batteries (Nickel Cadmium)

1. Amco Batteries Ltd.
2. HBLNIFE Power Systems Ltd.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

ANNEXURE - IV

CHECK LIST (To be filled up by tenderer)

Sl. No	Description	REMARKS
1	Deviation from specification	
2	Charger sizing calculation enclosed	
3	Battery sizing calculation enclosed	
4	Battery catalogue enclosed	
5	UPS Catalogue enclosed	
6	Confirm compliance to Block diagram	
7	Confirm Inspection for UPS and battery as per specification.	
8	Dimension for UPS Panel, rectifier and Battery Bank enclosed.	
9	Break up for two years operation & maintenance spares enclosed for UPS & Rectifier	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

DATA SHEET FOR
LV SMALL POWER DISTRIBUTION BOARD

DATA SHEET NO. -

ANNEXURE - I

Switch Board

1.1	Rated voltage and frequency	415V, 3phase, 4 wire, 50Hz
1.2	Maximum voltage	500V
2.0	Continuous current rating at design ambient temperature	As per approved SLD at 45°C with IP 52 enclosure
3.0	Type of enclosure as per IS 2147	IP 52
3.1	Minimum thickness of sheet steel	2mm
4.0	Applicable standards	IS 2147, 8623
5.0	Design ambient temperature	45°C
6.0	One second short time rating of switch board with minimum busbars, feeder busbars, kA(RMS)	As per SLD
7.0	Dynamic through fault current with complete busbars, kA (peak)	
8.0.	The formation (Max.)	Max 6
9.0	Maximum No. of cable terminations in each type of cubicle	
9.1	Size and no.	As per SLD
10.0	Incoming termination of LT switch board	As per SLD
11.0	Incoming termination top/bottom	Bottom for cable Top for busduct
12.0	Outgoing feeder cable entry top/bottom	Bottom
13.0	Minimum clearances at front and back of board	1.5m/1m
14.0	Dimensions LxBxH	
15.0	Maximum Dimensions of shipping sections LxBxH	2.5 x 1.5 x 2.4M
16.0	Min. clearances in air in mm	
16.1	Between phases	25.4mm
16.2	Between live parts and ground	19.0mm
17.0	One minute PF withstand voltage	2.5kV
18.0	Paint shade	631 of IS-5
	Busbars	
1.0	Busbar material & cross section	

1.1	Main busbars	E91E aluminium' Max. current density 0.6A/mm ²
1.2	Bus connections to circuit breakers	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

2.0	Continuous rating at design ambient	
2.1	Main busbars	As per SLD
2.2	Bus connections to circuit breakers	As per rated current of
3.0	Temperature rise at rated continuous current of the busbar in the busbar chamber	40deg.C over 45deg.C
4.0	Type of busbar insulators	Resin cast/fibre glass
	Breakers/SFU	
1.0	Type of breakers	As per SLD
2.0	Standards applicable	IS 13947-2/IEC947 – part-II
3.0	Rated service voltage	415V, 3ph., 50Hz
3.1	Highest system voltage	500V, 3ph., 50Hz.
4.0	Rated current at design ambient for breakers	As per SLD
4.1	Rated with breaker in IP 52 enclosure in two tier formation in the LT switch board	As per SLD
5.0	Symmetrical breaking capacity im kA (RMS)	
	-at 415V, 0.25 PF	50 kA RMS
	-at 440V, 0.25 PF	50 kA RMS
6.0	Making capacity kA (Peak)	105kA Peak
7.0	Capacitor breaking capacity at 440V	Incomer: 600A (min.) Outgoing: 300A(min.)
8.0	1 sec. Short time rating, kA (RMS)	50kA RMS
8.1	With release in any setting	50kA RMS
9.0	Thermal release setting ranges (temperature compensated)	As per SLD
10.1	Short circuit release range	As per SLD
10.2	Short circuit release timer setting range	0.1 to 0.6 sec. mechanical
Note	All the releases O/L, S/C and E/F shall be Static/microprocessor based.	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**DATA SHEET FOR
DISTRIBUTION TRANSFORMER**

DATA SHEET NO.

ANNEXURE – I

PURCHASER'S DATA DISTRIBUTION TRANSFORMER

GENERAL DATA			
1	Type of Transformer	ONAN, Hermetically sealed type	
2	Quantity	As per SOR	
4	Continuous Rating	As per SOR	
5	Type of cooling	ONAN	
6	Oil type	Mineral and comply the requirements of IS: 335.	
7	Climate	Humid & Heavy Rainfall during Monsoon	
8	Altitude	As per design basis	
9	System earthing	Solidly earthed	
10	Ambient temperature	Max.	As per design basis
		Min.	
11	Temperature rise	Oil measured by thermometer	45° C
		Windings measured by resistance method	55° C
12	Paint shade	631 of IS - 5	
13	Name Plate	As per IS: 1180	
15	Oil	Included	
16	Duty	Continuous	
17	No of Phases	3	
Electrical data			
18	Frequency	50 (± 3%)	
19	Phase	Three	
20	Winding Conductor	Copper	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

21	Voltage ratio	11/ 0.433KV
22	Winding Connection	Δ/λ
23	Vector group	DYN 11
25	% impedance	4.5 % (Tolerance as per IS:1180)
27	Insulation class	Type E
28	Neutral Grounding	Solidly Earthed/ As per SOR
30	Tap Changer on primary side	N/A
31	One minute dry & wet power frequency withstand voltage	
	HV side	10kV for 3.3 kV incoming supply 20kV for 6.6 kV incoming supply 28 kV for 11kV incoming supply
	LV side	3kV
32	Impulse Withstand voltage	45kV for 3.3 kV incoming supply 60kV for 6.6 kV incoming supply 75 kV for 11kV incoming supply
33	Withstand time without injury for 3 Phase Short circuit in transformer	3 Sec
34	Short circuit levels on HV terminal	Min 26.2 kA for 3 sec or As per SEB regulation
35	Short circuit levels on LV terminal of transformer	25 kA for 3 Sec
37	Auxiliary Supply Voltage	230V AC
38	Over load capacity	As per IS: 1180 and 2026
39	Max. Permissible Flux density	As per IS: 1180
40	Magnetizing Currents	As per IS: 1180
41	Winding insulation	Uniform
42	Neutral CT rating	As per manufacturer standard
43	Radiators	Detachable type on tank as applicable
44	Marshalling box	Shall be provided with OTI & WTI



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

45	HV Termination, LV Termination details	Primary	Cable box/Suitable Connector Provided for connection of ACSR conductor.
			Cable size/ Conductor Size/Type: Decided During detail Engg.
		Secondary	Cable box
			Cable size / Type: Decided During detail Engg.
Neutral Termination	Through NCT to Neutral Bushing at Cable Box		
46	Primary fault level	500 MVA	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Annexure-II

TECHNICAL DATA TO FURNISH BY CONTRACTOR


1.	% Reactance at rated current & frequency	
2.	% Resistance at rated current & frequency	
3.	Total loss at rated voltage & frequency	
4.	Component Loss	
	a) No load loss at rated voltage & frequency	
	b) Load loss at rated current at 75°C	
5.	No load current	
	At 10 % V	
	At 110 % V	
6.	Efficiency at 75°C and unity pf	
	At full load	
	At ¾ load	
	At ½ load	
7.	Efficiency at 75°C and 0.8 pf lag	
	At full load	
	At ¾ load	
	At ½ load	
8.	% Regulation at full load at 75°C	
	At unity pf	
	At 0.8 pf lag	
9.	Efficiency at 0.9 pf @ 40% load	
Mechanical data		
A)	Weights in kg	
1.	Core & Winding	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II


2.	Tank, fittings & accessories	
3.	Radiator W /O oil	
4.	oil	
5.	Total Mass	
6.	Oil quantity required for first fill ltrs.	
B)	Overall Dimension (mm)	
1.	Length	
2.	Breadth	
3.	Height	
4.	Paint	
5.	Paint Shade	
6.	Roller	

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Annexure – III

LIST OF SPARES — FOR 2 YEARS OPERATION & MAINTENANCE

1.	Set of gasket	1 Set
2.	Bushing	
	HV	1 Set
	LV	1 Set
	LV Neutral	1 Set
3.	Breather	1 Set
4.	Oil temperature Thermometer	1 Set

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

Annexure-IV

CHECK LIST (To be filled up by Tenderer)

Sl.No	Description	Remarks
1	Deviation from specification	Offer may be rejected if there is any deviation.
2	Filled-Up Data sheet	
3	Transformer Mounting Arrangement	
4	List of bought out items	
5	General arrangement Drawing showing overall transformer dimensions with radiator & conservator	
6	Unpriced item wise break up for two years operation & maintenance spares for transformers.	
7	Unpriced schedule of rate (SOR) enclosed.	



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

STANDARD SPECIFICATIONS (ELECTRICAL SYSTEM)



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

LIST OF STANDARD SPECIFICATIONS (ELECTRICAL)

SI No.	Description	Document No./ Drawing No.	Rev. No.
1	Cable laying		
2	Earthing and Lightning Protection		
3	Electrical Installation In Buildings		
4	Outdoor Lighting		
5	UPS		
6	Electrical Equipment Installation		
7	HV & LV Cable		
8	Power & Lighting Distribution Board		
9	Light Fittings For Hazardous Locations		
10	Capacitor Bank		



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
CABLE LAYING**

SPECIFICATION NO. -



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

C O N T E N T S

SL NO.	DISCRIPTION
	SCOPE
2.0	STANDARDS
3.0	GENERAL REQUIREMENT
4.0	CABLE SPECIFICATIONS
5.0	MISCELLANEOUS MATERIALS SPECIFICATIONS
6.0	CABLE LAYING
7.0	TERMINATION
8.0	TESTING
9.0	DOCUMENTATION



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 SCOPE

The intent of this standard specification gives recommendation & Board Guideline for selection, transportation, laying, jointing, termination, testing and commissioning of the cabling system up to 33kV.

2.0 STANDARDS

The work shall be carried out in the best workmanship like manner in conformity with this specification, the relevant specifications, codes of practice of Indian Standards Institution, approved drawings and instructions of Engineer-in-Charge or his authorised representative issued from time to time. In case of any conflict between the standards, the instruction of Engineer-in-Charge shall be binding.

In general the equipment covered by this specification shall, unless otherwise specified, be in line with the requirement of any of the latest applicable standards of

- a) Bureau of Indian Standards
- b) British Standard Institution
- c) American Standard Institution
- d) International Electro Technical Commission

2.2 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.2 In case any contradiction between various referred standards/specification/data sheets and statutory regulation etc the following order of priority shall be govern -

- i) Schedule of rates
- ii) Design Basis
- iii) Scope of work/Job specification
- iv) Data Sheet
- v) Standard specification
- vi) Codes & standard

3.0 GENERAL REQUIREMENTS

3.1 ENVIRONMENTAL CONDITIONS


The cables shall be laid for continuous operation at full load under the climatic and environmental conditions as described in the specification "Design Basis Electrical".

3.2 COMPONENTS AND EQUIPMENT

- a) The Contractor has to take care that all components, equipment & cable routes are selected considering easy maintenance, simple and quick diagnosis and long maintenance intervals. All components and equipment shall be designed for continuous duty at rated load and under the given climatic conditions. Standard industrial high performance systems and components shall be used as far as possible.

3.3 TAGGING

All components, equipment, cable route and installations shall receive the respective tagging plates, labels, etc which have to be of extremely durable material resistant against the

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

environmental conditions.

4.0 CABLE SPECIFICATIONS

Refer Specification for HV & LV Cable (Specification No.)

5.0 MISCELLANEOUS MATERIALS SPECIFICATIONS

5.1 Connectors

The cable accessories shall include end termination kits, straight through joints and also any special tool and tackles and accessories required for making the joints/terminations. Cable terminations shall be made with Aluminium/tinned copper crimped type solder less lugs of approved make for all Aluminium/Cu conductors cables and stud type terminals and shall be as per IS: 8309.

The straight through joint/termination arrangement shall be complete with all fittings and consumables. The joint shall have electrical and mechanical withstand capability, same as that of the associated cable. For all cables, a minimum extra length of 2 metres will be left before jointing. The termination kit shall be of heat shrinkable type only.

The termination kits/straight through joints shall have the following features:

- Electrical stress control to be provided at the cable insulation shield terminus.
- An external leakage insulation to be provided between the cable conductors and ground.
- Adequate protection to be provided at the end of the cables against the entrance of the moisture and, provision to maintain the constant pressure in the cable

5.2 Cable Identification

Cable tags shall be of 2 mm thick, 20 mm wide aluminium strap of suitable length to contain cable number, equipment no etc.


All cables shall be provided with identification tags indicating cable numbers in accordance with the cable/circuit schedule. Tags shall be fixed at both ends of cable, at joints and at 20 m spacing for straight runs. When a cable passes through a wall, tags shall be fixed at both sides of the wall. The tags shall be of aluminium sheet with the numbers punched on them and securely attached to the cables with non-corrosive wire. For single core cables wire shall be non-ferrous material. Individual cores of control cables shall have for identification, plastic ferrules with engraved numbers at both ends of the circuit.

5.3 Ferrules

Ferrules shall be of approved type size to suit core size mentioned and shall be employed to designate the various cores of control cable by the terminal numbers to which the cores are connected for case in identification and maintenance. Ferruling shall be done at both end of cables.

5.4 Cable Glands

Cable glands shall be nickel-plated Brass double compression type of approved/ reputed make with tinned copper lugs. Sealing kits with associated accessories like stress relieving cones, insulating tape, trifurcating boot, HT insulating tape, etc. Glands for classified hazardous areas shall be certified by CMRS and approved by CCE, Nagpur.

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

5.5 Cable trays

This shall be either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron trays as specified elsewhere. Prefabricated hot dip galvanized sheet steel cable trays shall be used for maximum support span of 2000 mm unless design is approved for larger span. For requirements of larger than 750 mm width two trays shall be run side by side. Cable trays shall be suitable for a cable weight of 50 kg/meter running length of tray. Minimum thickness of sheet steel/galvanizing shall be 2mm/86 microns respectively.

Power cables shall be laid on ladder type cable trays. Ladder type cable racks shall be selected from three sizes viz., 300, 450 and 600 mm and shall be fabricated from 50 x 50 x 6 mm MS angles for longitudinal members and 30 x 6 mm MS flats for cross members placed at an interval of 300 mm along the length of the rack with a provision of double cross members at locations, where cables are to be clamped. Supporting brackets for ladder type racks shall be provided at an interval not exceeding 1500 mm. Both horizontal and vertical members shall be of 50 x 50 x 6 mm MS angle and the bracket shall be welded to the embedded inserts or as approved by engineer-in-charge. Alternatively prefabricated sheet steel/ aluminium racks and supporting brackets of bolted construction may be used for power and control cables.

Vertical spacing between cable racks shall be between 300 mm to 250m depending upon size and number of cables.

If unit rate is not included in schedule of rates, then cable trays if required, shall be fabricated and installed at site as per ton rate for electrical structural supports etc.

5.6 GI Pipes

GI pipes shall generally be adopted for routing cables embedded through concrete foundations/ floors/walls (including the portion above floor level to be laid in continuation for protection against mechanical damage) generally in plant buildings. These shall be medium gauge, hot dip galvanized, electric resistance welded (ERW) screwed type conforming to IS:1239-1990 (Part-I). All pipe fittings shall conform to IS:1239 -1992 (Part-II). Not more than 40% of GI pipe cross sectional area shall be used(Blocked).


G.I conduits shall generally be used for exposed cabling along building walls/structures etc. in both plant and non plant buildings as well as concealed cabling in offices, canteens and other non plant buildings. These shall be of galvanized steel, screwed type conforming to IS:9537-1981 (part-II). Conduit accessories and fittings shall be of standard types conforming to IS:3837-1976.

All GI pipes/conduits shall be provided with pull wires to facilitate cable pulling.

GI pipe/conduit runs shall not have more than three 90 bends (2700 total) including bends immediately at the outlet or fitting. Straight runs shall be limited to 30 m by providing approved type pull/junction boxes as required.

Normally, no joints shall be made in through runs unless same is more than standard cable lengths. In cases where a jointing is to be done, the same shall be made with proper jointing material and kits.

G.I conduit/PVC pipe systems shall be firmly supported in position by means of heavy gauge saddles either screwed to concrete/brick walls using suitable plugs or screwed to MS brackets/cleats welded on to building structures. The spacing between support for both horizontal and vertical runs shall not be more than 1000 mm for straight runs. At or termination to junction/pull boxes, the nearest support shall be 300 mm from such fittings. Exposed GI conduits shall run parallel or perpendicular to column/building lines to match the existing architectural arrangement.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Embedded GI pipes shall however, run in direct lines with minimum bends. Bends for GI pipes/conduit where required shall be made such that the diameter of the pipe is not deformed. The radius of inner edge of field bend shall not be less than 8 times diameter for GI pipes and 6 times for conduits.

In damp locations exposed GI conduit and fittings shall be made water tight. Also, the conduit shall be mounted on steel spacers having a minimum thickness of 6 mm. Stub ups of embedded GI pipes shall be fitted with coupling plugged suitably to avoid damage to threads or entry of foreign matters during construction.

GI pipes/conduits shall be selected on the basis of percent fill in area as given in IS:1239- 2004 (Part-I) for medium gauge GI pipe as per IS 9537-1981 (Part-II).

6.0 CABLE LAYING

Cable network shall include power, control, lighting and communication/signal cables, which shall be laid in trenches, cable trays or conduits as detailed in the relevant drawings and cable schedules. Erection of cable trays as required shall be checked after erection and marked in as built drawings. Cable routing given on the layout drawings shall be checked in the field to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc and minor adjustments shall be done to suit the field conditions wherever deemed necessary without any extra cost.

High voltage, medium voltage and other control cables shall be separated from each other by adequate spacing or running through independent pipes, trenches or cables trays, as applicable as per IS 1255.

All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient lengths for the final connection of the cable to the terminal of the equipment. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. The quantity indicated in the cable schedule is only approximate. The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other works. Before the start of cable laying, cable drum schedule shall be prepared by contractor and get that approved by Engineer-in-Charge to minimize/avoid straight through joints required. Contractor shall work out the actual number of straight through joints required.

Laying & installation of Cable Routes

6.1 Cables laid on walls, structures, concrete trenches & cable tunnels

- 6.1.1 In the plant buildings, substations, switch/control rooms etc. power and control cables shall generally be taken exposed on brackets, cable racks/hooks laid in tunnels, concrete trenches, cable cellars, basements, cable galleries or along building and technological structures.
- 6.1.2 In the auxiliary shops and utility buildings, power and control cables shall generally be taken on cable racks either laid in concrete trenches or supported from building structures, walls, ceiling etc.
- 6.1.3 Power and control cables installed along buildings and technological structures, ceiling, walls etc which are required to be protected against mechanical damage and/or radiation of heat shall be taken in GI conduits. GI conduits shall also be used for flame-proof installation, where required. In corrosive atmosphere where 1,100 V grade cables are required to be taken in pipes, rigid heavy duty PVC pipes shall be adopted. Where direct heat radiation exists, heat isolating barrier shall be provided.
- 6.1.4 Cables to individual drives, control devices etc shall be taken in embedded/ exposed rigid GI pipes/ flexible conduits. Extra length of cables shall be provided suitably where possible for any future



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

contingency.

6.1.5 For interplant cabling in plant outdoor yard, the power and control cables shall generally be laid in the manner as follows:

- Directly buried in ground or in concrete trenches with cables laid on rack.
- In underground cable tunnels and overhead cable galleries, for main distribution feeders and for locations having large number of cables.
- In concrete ducts buried in ground, where direct burial and provision of concrete trench/tunnel are not possible due to presence of other service lines.

6.1.6 All cables irrespective of type of installation shall be protected by means of GI pipes or sheet metal protective cover up to a height of 1500 mm from the working floor level and platforms for protection against mechanical damage.

6.1.7 For higher size cables a loop of about 4/5m is to be kept in the cables for meeting future contingency of jointing/termination length.

6.1.8 For 415 V power wiring in auxiliary buildings offices and laboratories etc cables shall be taken in embedded/exposed GI conduits or rigid PVC pipes.

6.1.9 The installation work shall be carried out in a neat workman like manner by skilled, experienced and competent workmen, with experience in jointing and termination of aluminium conductor cables. Cable runs shall be uniformly spaced, properly supported and protected in an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of the cable.

6.1.10 The bending radius of various types of cables shall be as per IS: 1255-1983:

Type of cable and voltage	Minimum bending radius		
	Grade	Single core	Multi core
			Unarmoured Armoured
11 kV XLPE cables		20 D	15 D 15 D
1.1 kV PVC cables		15 D	12 D 12 D

6.1.11 Cable installation shall be properly co-ordinated at site with the routing of other services/utilities. Where necessary, suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services. Exit of cables from underground trenches or tunnels shall be through pipe sleeves. Pipe sleeves shall be properly sealed. Pipe sleeves shall be laid at an angle of maximum 45° to the trench wall. In case of larger diameter cables, i.e., 50 mm and above, adequately sized pipe with larger bend radius shall be provided for ease of drawing of cable or for replacement. In places where it is not possible, a smaller trench may be provided if approved by Engineer-in-Charge.

6.1.12 All cables shall be tested for proper insulation prior to laying. The cable drums shall be transported on wheels to the place of work. The cable shall be laid out in proper direction as indicated on the drum using cable drum stands. In case of higher size cables, the laid out finally transferred carefully on to the trenches and racks. Care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Approved cable pulling grip or other devices shall be used.

6.1.13 Adequate length cables shall be pulled inside the switchboards, control panels, terminal boxes



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

etc so as to permit neat termination of each core/ conductor. Control cables entering switchboard or control panels shall be neatly bunched/strapped with PVC perforated tapes and suitably supported to keep it in position at the terminal block. All spare cores shall be neatly dressed and suitably tapped at both ends.

6.1.14 Power cable terminations shall be carried out in such a manner as to avoid strain on the terminals by providing suitable clamps near the terminals. All power cable terminations shall be by means of crimping type cable lugs. Control cables shall be terminated directly at the terminal blocks by screws.

6.1.15 No joint shall normally be made at any intermediate point in through runs of cables unless the length of the run is more than the length of standard cable drum. In cases where jointing is unavoidable, the same shall be made by means of standard cable jointing kits. All opening for cable entry in the equipment shall be sealed and made proof against entry of creeping reptiles.

6.1.16 Power cables of different voltage grades shall be laid in separate racks/ hooks. Control cables as well as signal and communication cables shall be laid in separate racks. The cables in racks/hooks shall be laid in the order of their voltage grades such that the cables of lowest voltage grade are on the topmost tier and highest voltage grade on the bottom-most tier. Where there is possibility of mechanical damage to cable rack, sheet steel covers shall be provided for adequate protection.

All communication/signal cables (telephones, P.A.S, Instrument) RTD Cables shall run on instrument trays/ducts/trenches. Wherever these are not available, cables shall be taken in a separate trench with a minimum clearance of 300 mm away from electrical trench as per IS 1255 & direction of Engineer-in-Charge. Communication cables shall cross power cables at right angles.

Clearance –The desired Minimum clearance are as follows-

Power Cable to Power Cable - Clearance is not necessary. However, there would be some clearance so that, the current carrying capacity become better.

Power cable to control cable - 0.2m
Power cable to communication/ - 0.3m Signal cable
Power cable to Gas/Water Main - 0.3m

Inductive influence/interference on signal/control/communication cable should be checked.

The Power cable should not be laid above the Communication Cable. While laying of power cables the likely interference to existing communication/signal cable should be avoided by referring to and coordinating to appropriate authority.

6.1.17 For future installation of cables, provision shall be made to keep 20 percent space as spare on each rack. Alternatively, one spare rack can be provided all along the route. Cable racks shall be so arranged that they do not obstruct or impair movement in passage way. Particular attention shall be given to this aspect at rack crossing in cable tunnels and cable cellars where a minimum clearance of around 1800 mm shall be kept for free movement. For dusty area cable racks shall be vertical type(for horizontal run).

6.1.18 For laying cables along steel/ technological structures on concrete walls/ceiling etc. the cable shall be taken by clamping with MS saddles screwed on to MS flats welded to the structure or to embedded inserts provided in walls. Where inserts are not available the saddles may be directly fixed to the walls using drawl plugs and MS flat spacers of minimum 6 mm thick.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

6.1.19 The MS saddles shall be placed at an interval of not less than 500 mm both for horizontal and vertical runs. However, at bends, it shall be placed within 300 mm and when terminated to equipment/junction box the cable shall be clamped immediately before such termination. In areas prevailing with corrosive atmosphere, PVC saddles instead of MS saddles shall be provided.

6.1.20 The termination of GI pipes/conduits to rotating or other equipment subject to vibration or connection/disconnection at intervals shall be made by means of flexible metallic conduits. The use of flexible metallic conduits in outdoor locations shall be avoided as far as practicable.

6.1.21 Flexible pipes shall be liquid tight, galvanized heavy duty interlocked type with extruded PVC jacket on top generally conforming to IS:3480-1966. The adapter for coupling flexible conduit to rigid pipes/equipment shall be of cast aluminium, screw/gland type. Alternatively, steel wire reinforced PVC hose may be used with matched adapters.

6.1.22 All fabricated pull/junction boxes shall be made of 3 mm thick sheet steel, painted as specified. The pull boxes shall be sized to suit the largest recommended bending radius of the cables to be accommodated. Larger boxes (generally exceeding 600 mm in length) shall be fabricated with standard steel sections.

6.1.23 RCC cable trenches with removable covers as shown on the drawings will be provided by the Owner. Cables shall be laid in 3 or 4 tiers in these trenches as indicated on the sectional drawings. Concrete cable trenches shall be filled with sand where specified to avoid accumulation of hazardous gases, RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. Removal of concrete covers for purpose of cable laying and reinstalling them in their proper positions after the cables are laid shall be done by the electrical Contractor at no extra cost.

6.1.24 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection upto a minimum of 300 mm above grade or as shown in the standard drawings.

6.2 Buried Cables

6.2.1 Power and control cables laid directly buried in ground shall be laid as per the requirements of code of practice IS: 1255-1983. Generally cables shall be taken at a depth of 1000 mm from finished ground level.

6.2.2 For laying of multiple 11 kV grade power cables horizontal axial spacing shall be 250 mm. For 1100 V grade power cables, the horizontal axial spacing shall be 150 mm. Control cables shall be laid touching each other without any horizontal spacing. However, the distance of the control cable from the nearest power cables shall be 200 mm. Power and control cables may be laid in a common trench, but power cables for each voltage grade and the control cables shall be laid separately in groups. Generally cables shall be laid in one layer. In general, communication cables shall not be taken in a common trench. In case the same is required to be taken along with power cables, the minimum axial spacing between two cables shall be 300 mm.

6.2.3 Directly buried cables shall be laid underground in excavated cable trenches where specified in layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables correctly spaced and arranged with a view of heat dissipation and economy of design.

6.2.4 Desired Minimum depth of laying from ground surface to top of cable is as follows-

High voltage cables, 3.3kV to 11kV Rating	:	0.9m
High voltage cables, 22kV to 33kV Rating	:	1.05m
Low voltage & control cable	:	0.75m
Cables at Road Crossing	:	1.00m
Cables at railway crossing (Measured from	:	1.00m



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Bottom of sleepers to top of pipe)

The depth and the width of the trench shall vary depending upon the number of layers of cables.

6.2.5 Precast concrete protective cover shall be placed centrally along the cables. The concrete slab shall be of RCC type as per Appendix-C of IS:1255-1983 having suitable provision for dovetailing with the adjacent slab. The length depending on the number of cables in the trench as well as axial spacing. The minimum width of slab shall not be less than 200 mm.

6.2.6 After laying of cables, the trench shall be back filled with good excavated soil and well rammed in successive layers not less than 300 mm depth. The excavation of trenches shall be done with vertical sides and trenches shall be kept as straight as possible. The width of trench shall be in accordance with the number of cables to be laid out but in no case shall be less than 400 mm. The minimum clearance between trench edge and cable shall not be less than 100 mm. At turning and tee-off points of the cable trench suitable chamfering shall be made keeping in view the minimum bending radius of cables.

Cable ends shall be carefully pulled through the conduits, to prevent damage to the cable. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.

Following grade of the pipe fill shall be used for sizing the pipe size:

- | | | | |
|----|------------------|---|----------|
| a) | 1 cable in pipe | - | 53% full |
| b) | 2 cables in pipe | - | 31% full |
| c) | 3 or more cables | - | 43% full |
| d) | Multiple cables | - | 40% full |

6.2.7 Where cables are required to cross roads, railways tracks and surface drains they shall be taken through reinforced concrete spun pipes at a minimum depth of 1000 mm. For crossing water oil, gas or sewage pipes etc. cables shall be taken above the pipes where minimum 500 mm clearance is available from top of pipes. Where 500 mm clearance is not available, the cables shall cross these pipes through RC pipes at minimum depth of 750 mm from finalized ground level keeping distance of 300 mm between the utility and cable pipes.

6.2.8 In each cable run some extra length shall be kept at a suitable point to enable one or two straight through joints to be made in case the cable develops fault at a latter date. Also when group of cable are laid together the cable length shall be adjusted to stagger the straight through joints.

6.2.9 Directly buried underground cable shall be generally laid by the utility alley along the roads and cable routing shall follow the road layout. However, in special cases to keep the cable lengths minimum the cables may be laid by the shortest route and the same shall be taken through RC pipe where required.

6.2.10 Galvanised iron cable markers and identification tags shall be provided at each joint, entry to building/tunnels, each turn, either side of the road crossings and at 30 m intervals for straight cable runs. The markers shall be conspicuous and fixed in concrete block in a durable manner.

6.2.11 Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cables leaving trenches shall be coiled and provided with a protective pipe or cover, until such times the final termination to the equipment is connected. Minimum bending radii of cable shall be as specified in IS: 1255.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**


VOLUME II OF
II

- 6.2.12 Cables shall be laid in trenches at depth as shown in the drawing with protective GI earth conductor (runs along the cable). Before cables are placed, the trenches bottom shall be filled with a layer of sand. This sand shall be leveled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the largest diameter cable and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall then be laid flat. The remainder of the trench shall then be back-filled with soil, rammed and leveled.
- 6.2.13 As each row of cables is laid in place and before covering with sand every cable shall be given an insulation test in the presence of Engineer-in-Charge / Owner. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.
- 6.2.14 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/ lined trench.
- 6.2.15 After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/ 'PUTTI' for sealing purpose. The cost for the same shall be deemed to have been included in the installation of G.I. Pipe and no separate payment shall be allowed.
- 6.2.16 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Engineer-in-Charge before cutting is done.
- 6.2.17 Individual cables or small groups which run along structures/walls etc. will be clamped by means of 10 SWG GI saddles on 25x6 mm saddle bars. The cost of saddle and saddle bars shall be deemed to have been included in the installation of cables and no separate payment shall be made on this account. Alternatively small group of cables can be taken through 100 mm slotted channel/ISMC 100.
- 6.2.18 They shall be rightly supported on structural steel and masonry, individual or in groups as required, if drilling of steel must be resorted to, approval must be secured and steel must be drilled where the minimum weakening of the structure will result.
- 6.2.19 Cables shall be supported so as to prevent unsightly sagging. In general distance between supports shall be approximately 300 mm for cables upto 25 mm diameter and maximum 450 mm for cables larger than 25 mm diameter.
- 6.2.20 Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. Saddles/Clamps, whereas cable in horizontal run of cable trays shall be tied by means of nylon cords.
- 6.2.21 Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint unless otherwise specified.

7 TERMINATION

- 7.1 All PVC cables upto 1.1 KV grade shall be terminated at the equipments by means of double compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.

All Cable entries shall be through bottom only and top entry terminations are made only after getting

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

approval of Engineer-in-Charge.

- 7.2 Power cables wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminum connections are made, necessary bimetallic washers shall be used for trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.
- 7.3 In case of control cables, all cables shall be identified at both ends by their terminal numbers by means of PVC ferrules or self-sticking cable markers. Wire numbers shall be as per schematic/wiring /inter- connection diagram. Bidders shall have the samples of PVC ferrules/cable markers approved before starting the work. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends.
- 7.4 Where threaded cable gland is screwed into threaded opening of different size, suitable galvanized threaded reducing bushing shall be used of approved type, at no extra cost. All switchgear and control panels shall have un-drilled gland plate.

Contractor shall drill holes for fixing glands wherever necessary at no extra cost. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables.

- 7.5 The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.
- 7.6 In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit hole should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the center line of holes. After installation of bottom plate and cables it should be sealed with cold setting compound. Cables shall be clamped over the open armouring to connect it to earth bus.
- 7.7 Cable leads shall be terminated at the equipment terminals, by means of crimped type solderless connectors.
- 7.8 Crimping shall be done by hand crimping hydraulically operated tool and conducting jelly shall be applied on the conductor. Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.
- 7.9 Termination and jointing of aluminium conductor power cables shall be by means of compression type aluminium lugs. Alternatively, tinned copper compression type lugs may also be used with application of corrosion inhibiting compound. Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment.
- 7.10 The jointing and end sealing kits shall be complete with stress relief system and all accessories, straight through joint for direct burial installations shall be provided with cast resin enclosure for protection against water and corrosion.
- 7.11 Straight-through joints for 1100 V grade PVC insulated cables shall be with epoxy resin compound for direct burial cables. Cable glands for terminating PVC insulated, armoured/ unarmoured cables shall be made of brass or aluminium alloy.
- 7.12 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all XLPE/PVC insulated cables shall be taped with an approved



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.

7.13 Cable accessories for H.V. Systems

7.13.1 The 11, 6.6 and 3.3 KV cables terminations joints shall be done by skilled and experienced jointers duly approved by the Engineer-in-Charge. Termination including supplying of jointing kit shall be in the scope of contractor unless specified otherwise.

7.13.2 The termination and straight through joint kit for use on high voltage system shall be suitable for the type of cables or the type of cables issued by owner for installation. Supply of termination kit shall be in the scope of contractor. The materials required for termination and straight through joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fitting and consumables items. An installation instruction shall be included in each sheet.

7.13.3 The termination kits shall be suitable for termination of the cables to indoor switchgear/panels or outdoor weatherproof cable box or outdoor transformer & motors or Double/Four pole structure. The terminating kits shall preferably be of the following types:

- a) Heat-shrinkable power cable termination/joint kit of M/s. Raychem or equivalent.

For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

7.13.4 The straight through jointing kits shall be suitable for underground-buried installation with uncontrolled backfill and possibility of flooding by water. The jointing kit shall be one of the following types.

- a) Heat-shrinkable sleeve type of M/s. Raychem or equivalent.

7.13.5 Makes of kits other than those specified above may be considered, provided the Contractor furnishes type test certificates, along with the offer for approval of the same.

7.13.6 Type tests are to be carried out at manufacturer's works to prove the general qualities and design of a given type of termination/jointing system. The type tests shall include the following tests conforming to the latest IEC 502.2, 466 and VDE 0278 specifications. The type test certificates shall be submitted by the Contractor along with the offer for indicating the jointing system considered.

- a. A.C. Voltage withstand dry test for 1 minute
- b. Partial discharge test - Discharge magnitude shall be less than 20 p.c.
- c. Impulse voltage withstand test with 10 impulses of each polarity.
- d. A.C. high voltage test following load cycling test with conductor temperature at 95°C.
- e. Thermal short circuit test of 250°C for 1 second.
- f. DC Voltage withstand test for 30 minutes.

- g. Humidity test.
- h. Dynamic short circuit test.
- i. Salt log test
- j. Impact test

8 TESTING



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- 8.1 Before energizing, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground.
- 8.2 Where splices or termination are required in circuits rated above 600 volts, measure insulation resistance of each length of cable before splicing and or/ terminating. Repeat measurement after splices and/or terminations are completed.
- 8.3 Measure the insulation resistance of directly buried cable circuits before cable trenches are back-filled. Repeat measurement after back- filling.

Rating of IR tester for cables of different voltage rating as follows-

Cable Voltage grade	IR Tester Voltage Rating
1.1kV	500V
3.3kV	1000V
6.6kV	1000V
11kV	1000V

- 8.4 Cables after jointing & termination are subjected to DC high voltage test. The recommended values of test voltage are given below.

Uo/U	Test Voltage Between	Conductor to Conductor (For Unscreened Cable)	Duration (Min.)
	Any conductor and metallic Sheath/ Screen /Armour		
0.65/1.1	3	3	
1.9/3.3	5	9	
3.3/3.3	9	9	
3.8/6.6	10.5	18	15
6.6/6.6	18	18	
6.35/11	18	30	
11/11	30	30	

- 8.5 All cables shall be tested as per standard test Performa available with site engineer.
- 8.6 Cable schedule and layout drawings must be marked for AS BUILT conditions during the installation work and shall be approved by Site Engineer.

9 DOCUMENTATION

After commissioning & testing of all power & control cables, contractor shall submit the following document to Client/ PMC for As-Built status in hard copy (5 set) plus one soft copy.

- i) Complete commissioning report of cables
- ii) Drawing showing Cable rout of all laid cables in trenches/trays including respective cable numbers.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
EARTHING AND LIGHTNING PROTECTION**

SPECIFICATION NO: -



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

C O N T E N T S

- 1.0 SCOPE
- 2.0 STANDARDS
- 3.0 TAGGING
- 4.0 EARTHING SYSTEM
- 5.0 EARTHING CONDUCTOR
- 6.0 DESIGN REQUIREMENT
- 7.0 EARTHING NETWORK
- 8.0 INSTALLATION OF EARTH ELECTRODE
- 9.0 CONNECTION
- 10.0 TESTING
- 11.0 LIGHTNING PROTECTION
- 12.0 COLLECTORS
- 13.0 TESTING OF LIGHTNING PROTECTION SYSTEM
- 14.0 DOCUMENTATION



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

AMENDMENT STATUS

Sl. No.	Clause / Paragraph / Annexure / Exhibit / Drawing Amended	Page No.	Revision	Date	By (Name)	Verified (Name)



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

The intent of this specification is to define the requirements for the supply, installation, testing, and commissioning of the complete Earthing & lightning protection System.

2.0 STANDARDS

The work shall be carried out in the best workmanlike manner in conformity with this specification, the relevant specifications/codes of practice of Indian Standard Institution, approved drawings and instructions of the Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instructions of Engineer-in-Charge shall be binding.

IEC 62305 Protection against Lightning
IS 2309 Protection of building and allied structure against lightning
IS 3043 Code of practice for earthing
NBC 2016 National Building code

2.1 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.2 In case any contradiction between various referred standards/specification/data sheets and statutory regulation etc the following order of priority shall be govern -

- i) Schedule of rates
- ii) Design Basis
- iii) Scope of work/Job specification
- iv) Data Sheet
- v) Standard specification
- vi) Codes & standard

3.0 TAGGING

All components, equipment and installations shall receive the respective tagging plates, labels, etc., which have to be of extremely durable material resistant against the environmental conditions. For further requirements, reference is made to the specification "Design Basis- Electrical".

4.0 EARTHING SYSTEM

General

Entire system shall be earthed in accordance with the provisions of the relevant IEC recommendations/ IS code of practice IS 3043-1987 and Indian Electricity Rules, so that the values of the step and contact potentials in case of faults are kept within safe

permissible limits. Parts of all electrical equipment and machinery not intended to be alive shall have two separate and distinct earth connections each to conform to the stipulation of the Indian Electricity Rules and apparatus rated 240V and below may have single earth connections.

The stations shall be equipped with an equipotentially meshed grounding network. All exposed conductive parts or elements of the station systems will be connected to this network. The earthing systems of the various stations are part of the protection systems for electrical power supply, instrumentation, control and supervisory system. The earthing system consists of the main grounding grid, the grounding rods, the building foundation grounding and the equipment grounding.

Supply of all other erection/consumable required to complete the installation shall be the responsibility of the contractor. All hardware used for earthing shall be hot dip galvanized.

Any other items not specifically mentioned here but necessary for completeness of job shall be in



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

the scope of contractor & shall be supplied by contractor without any extra cost.

All shops and buildings as well as the electrical sub-stations and electrical rooms shall be provided with a ring main earthing system each. Individual ring main earthing systems shall again be interconnected as a network.

For stations, which are to be extended, the existing earthing system shall be considered. The layout of new earthing system shall match to the existing installations. The new and the existing grounding network must be interconnected at two (2) locations, at least.

The ring earthing system around each building shall be laid at a distance of approximately 1.5 m from the building and at a depth of approximately 0.8m. The ring shall be bonded at intervals to the building steel structures, reinforcement of building columns and also to pipes, wherever they are crossing. The earth ring shall further be connected at intervals to deep earthing electrodes to achieve a combined earth resistance of less than one ohm.

The grounding network system will be installed in different locations have different soil characteristics according to the location of the stations. Before design and installation of the grounding network the actual soil conditions in the station areas must be determined by adequate soil resistance measurements by the contractor & submit for review & approval.

Station earthing should have low earth resistance, low touch & step potential.

5.0 EARTHING CONDUCTOR

The main grid conductor shall be hot dip galvanized G.I. Flat or PVC insulated copper conductor. Size & type of conductor shall be as marked on the drawings. Thickness of hot dip galvanizing shall not be less than 75 microns.

6.0 DESIGN REQUIREMENTS

6.1 The earth resistance of the overall interconnected station grounding network shall not exceed 1 Ω .

6.2 For the purpose of dimensioning the earthing lines/conductors, the duration of the earth fault current shall be taken as 0.3 seconds.

6.3 All exposed metal part such as HT/LT switchgear, DP/FP structure, distribution board, metal clad switchgear enclosure, lamp brackets, lamp holder, plug sockets, lighting poles, junction boxes, high mast etc shall be properly earthed by connecting these to the earth electrode by means of GI wire/Flat or PVC insulated Cu conductor of approved size to pass the fault current safely to earth in case of any fault.

6.4 For different floors in a building, localized ground mats shall be formed and connected to the ground earthing ring through vertical risers. The earthing mat shall be common to both power and lighting installations.

6.5 For the UPS, the SCADA and telecommunication systems with their equipment a separate grounding network with sufficient cross-section to avoid interference shall be installed. This grounding network shall be connected to the common station grounding network on one (1) separable and indicated connection point, within the electrical building or equipment container/enclosure.

6.6 Before design and installation of the grounding network the actual soil conditions in the station areas must be determined by adequate soil resistance measurements.

6.7 The required conductor spacing, the total length of the grounding grid and the required grounding material cross-section shall be calculated under consideration of the maximum earth fault current, to maintain touch and step voltages within reasonable limits. The impedance of the fault current



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

path and protective devices shall be chosen that the faulted circuit will be disconnected from the supply within the required time. A respective grounding calculation with report shall be performed for each station and is to be submitted to the Client/ PMC for approval.

6.8 Multiple connections of grounding conductors shall only be carried out above ground. For these connections the respective grounding bars are to be installed. Extensions of single grounding conductors can be permitted below ground under use of compression connectors or welding connections, with repair painting and coating of the connection point.

6.9 All connections of conductors on equipment shall be performed with pressure type lugs or connectors and threaded bolts, screws, spring-washers and washers. Special care must be taken to avoid the arising of a chemical element. Connections between bare copper and iron parts must be protected in a special manner and shall only be executed on above-ground connection points (grounding bars) or inside of pits.

6.10 The power supply cables (LT) from the sub-station and the distribution cables to individual motors shall have 4/3.5 cores. LT power supply cables shall have four cores and the fourth core shall have cross-sectional area of 50% of the other cores generally. The fourth core of the main supply lines shall be connected to the solidly earthed neutral bar in the substation switchgear as well as at the earth bars in MCC/distribution boards.

6.11 Separate electronic earthing system shall be provided for all electronic equipment like PLC"s, weighing panel, computer etc.

7.0 EARTHING NETWORK

7.1 The earthing installation shall be done in accordance with the earthing drawings and the standard drawings of reference attached with this document. The entire earthing system shall fully comply with the Indian Electricity Act and Rules. The contractor shall carry out any changes desired by the Electrical Inspector or the owner, in order to make the installation conform to the Indian Electricity Rules at no extra cost. The exact location on the equipment shall be determined in field, in consultation with the Engineer-in-Charge or his authorized representative. Any changes in the methods, routing, size of conductors etc shall be subject to approval of the Owner/ Engineer-in-Charge before execution.

7.2 Excavation and refilling of earth, necessary for laying underground earth bus loops shall be the responsibility of the contractor.

7.3 The main earth grid shall be laid at a depth of minimum 700 mm below grade level. Wherever RCC cable trenches are available, the earth lead shall be laid in the trenches and shall be firmly cleared to the walls of concrete lined trenches. The earthing strip shall be protected against mechanical damage.

7.4 A common grounding system network (Main earthing grid) will be made underground by using 50 mm x 6 mm GI earthing strip connected to earth electrodes in loop-in & loop-out system and connecting the electrical equipment to network. In RCC cable trench one number earth strip of size 50 x 6 mm shall be run throughout the length of the trench.

7.5 Earthing system around each building shall be laid at distance approximately 1.5 meter from the building & at a depth of approximately 0.8m. The ring shall be bonded at intervals to the building steel structure, reinforcement of building columns & pipes wherever they are crossing. The earth ring shall further be connected to deep earthing electrodes to achieve a combined earth resistance of less than One or Two ohm as specified earlier.

7.6 In process unit areas, the earthing cable shall be run along cable trays wherever specified in the layout drawings. The earthing cable shall be suitably cleared and electrically bonded to the cable



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

tray at regular intervals.

7.7 Joints and tapping in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below ground shall be welded and suitably protected by giving two coats of bitumen and covering with Hessian tape. All joints above ground shall be by means of connectors/ lugs as far as practicable. Tee connectors shall be used for tapping, earth leads from the main earth loop wherever it is installed above ground. Earthing plates shall be provided for earthing of two or more equipment at a place from earth grid. Where aluminium cable risers are to be connected to the underground GI earth bus, the aluminium cable riser shall be taken to the nearest earth pit and terminated through a bolted joint. If this is not practicable, then G.I. risers shall be brought above grade and a bolted joint shall be made between this GI riser and the aluminium cable termination. This G.I. Riser shall be protected applying two coats of bituminous paint/bitumen on the exposed portion.

7.8 Conduits in which cables have been installed shall be effectively bonded and earthed. Cable armours shall be earthed at both ends.

8.0 INSTALLATION OF EARTH ELECTRODES

8.1 Earth pipe electrodes shall be installed as shown in the earthing layout drawings shall be in accordance with the standard drawings, specification and IS: 3043. Their location shall be marked to enable accurate location by permanent markers.

8.2 All earth electrodes shall preferably be driven to sufficient depth to reach permanently moist soil. Electrodes shall preferably be situated in a soil which has a fine texture and which is packed by watering and ramming as tightly as possible. Wherever practicable, the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes.

8.3 All earth electrodes shall be tested for earth resistance by means of standard earth test meter. The tests shall take place in dry months. If necessary, a number of electrodes shall be connected in parallel to reduce the earth resistance, shall be in the scope of contractor. The distance between two electrodes shall not be less than twice the length of electrode.

8.4 The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.

8.5 Tentative no of earth pits shown in drawing are only for reference to the contractor. The exact location and number of earth electrodes required at each location shall be determined in the field in consultation with the owner/Engineer-in- Charge, depending on the soil strata and resistivity, to meet the ohmic values prescribed in clause 6.1. The contractor shall design the earthing system accordingly & submit for review & approval.

8.6 Earth Electrodes shall be located avoiding interference with road, building foundation, column etc. Individual earth electrode shall be provided for each lightning arrestor and lightning mast. The electrodes shall be so placed that all lightning protective earths may be brought to earth electrode by a short and straight a path as possible to minimize surge impedance.

8.7 The disconnect facility shall be provided for the individual earth pits to check their earth resistance periodically. All the earth electrodes shall be suitably numbered and this should be indicated in as built drawings.

9.0 CONNECTION

9.1 All electrical equipment is to be doubly earthed by connecting two points on equipment to a main earthing ring. The earthing ring will be connected via links to several earth electrodes. The earth grid formed shall be a closed loop as shown in the drawing with earth electrodes connected to the grid with double strip connection. The cable armour will be earthed through the cable glands.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

9.2 In hazardous areas all major process equipments shall be connected to the earthing ring by means of anti- loosening connections and all pipelines will be bonded and earthed on entering the battery limit of the process area.

9.3 The following shall be earthed.

1. Transformer neutrals & body
2. Double Pole & Four Pole structures
3. CT/PT neutrals
4. Neutral Grounding Resistors
5. Lightning Arrestors
6. All switchgear and their earth buses, bus duct
7. Motor Frames
8. UPS, Telecommunication system, RTU's, Control panels & other instruments etc.
9. Non-current carrying metallic parts of electrical equipment such as switchgear, switch racks, panel boards, motor control centres, lighting, power and instrument panels, push button stations, cable trays, pipes, conduits, terminal boxes, etc.
10. All fences, gates/enclosures, housing electrical equipment

Equipments

Earthing Conductor size (Indicative)

Grid & equipment such as Main Electrical Distribution Board, LT Switchboard, PDB, MLDB, Silent D. G. Set	:	50 x 6 mm GI Flat
Motors and starters over 45 kW and HT motors, Cable trays	:	50 x 6 mm GI Flat
Mechanical equipment / Vessels,Tanks, Pipe/cable racks, structure, fencing	:	50 x 6 mm GI Flat
Utility building PDB, LDB, Switch Socket DB, UPSDB, Lighting DB etc	:	25 x 5 mm GI
Motors and starters above 15 kW, and upto and including 45 kW	:	25 x 5 mm GI
RTU, Telecom, UPS	:	25 x 5 mm copper
Motors and starters above 3.7 kW and upto and including 15 kW.	:	16 sq mm stranded GI Wire
Product pipe line	:	16 sq mm flexible copper wires
Motors and starters upto and including 2.2kW, Light fitting, JB's, etc.	:	6 sq mm stranded GI Wire
FLP – WP lights/control station	:	6 sq mm stranded GI Wire
Instruments and miscellaneous small items protected by fuses of ratings not exceeding 15A.	:	6 sq mm stranded GI Wire
Field Instruments	:	2.5 sq mm PVC Cu Wire



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Jumper for flanges : 50 x 2 mm Copper Strip

11. All steel structures, rails etc. including bonding between sections
12. Shield Wire
13. Structural steel and Columns
14. Loading racks
15. Lighting Mast, poles
16. Lighting rods (Mast)
17. Tanks and vessels containing flammable materials.
18. Rotating parts of the agitators, pumps etc. through spring loaded brushes of suitable grade.
19. Earth continuity conductor shall be provided for flanges.

Conductor size for connection to various equipments shall be as indicated on Earthing Layout Drawings.

9.4 Two distinct conductors directly connected to independent earth electrodes, which in turn shall be connected to the earth and earth system. The earth connection shall be properly made. A small flexible aluminium cable loops to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastening bolts when there is a Lightning surge, high voltage surge or failure of the bushings.

9.5 The shield wire shall be connected with the main grid solidly and not through supporting steel structures.

9.6 All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.

9.7 All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground. In case of G.I. Earth Loop all underground "T" connections shall be of the same size as main loop however in case of PVC insulated aluminium conductor loops underground joints shall be completely avoided. Connections to motors from earth plate or main loop conductor brought above ground shall not be less than following:

Anchor bolts or fixing bolts shall not be used for earthing connection.

9.8 All hardware used for earthing installations shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections of equipment.

9.9 Lighting fixtures shall be earthed through the extra core provided in the lighting cable for this purpose.

10.0 TESTING OF EARTHING SYSTEM

Earthing systems/connections shall be tested as follows:

10.1 Resistance of individual electrodes shall be measured after disconnecting it from the grid.

10.2 Earthing resistance of the grid shall be measured after connecting all the electrodes to the grid. The resistance between any point on the metallic earth grid and the general mass of earth shall not exceed 1 ohm.

10.3 The resistance to earth shall be measured at the following:

- 1) At each electrical system earth or system neutral earth.
- 2) At each earth provided for structure lightning protections.
- 3) At one point on each earthing system used to earth electrical equipment enclosure.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- 4) At one point on each earthing system used to earth wiring system enclosures such as metal conduits and cable sheaths or armour.
- 5) At one point on each fence enclosing electrical equipment.

Measurement shall be made before connection is made between the ground and the object to be grounded.

11.0 LIGHTNING PROTECTION

11.1 Lightning protection system shall generally comprise air termination system (lightning finials, air terminals or collector rods, roof conductors or collector lines), down conductor system (down conductors & test links) and earth termination system (earth electrodes along with pits and strips). These individual elements of an LPS should be connected together using appropriate lightning protection components to ensure that in the event of a lightning current discharge to the structure, the correct design and choice of components will minimize any potential damage.

11.2 The number, types, materials and sizes shall be in accordance with the drawings. All lightning arrester earth leads of the buildings and plant units shall be connected to the cage ring.

11.3 All buildings and plant structures vulnerable to lightning strokes owing to their height or exposed situation shall be protected against atmospheric flash-overs and lightning strokes in such a manner as to eliminate any danger to the personnel employed therein.

11.4 Lightning affecting a structure can cause damage to the structure itself and to its occupants and contents, including failure of internal systems. The damages and failures may also extend to the surroundings of the structure and even involve the local environment. The scale of this extension depends on the characteristics of the structure and on the characteristics of the lightning flash.

11.5 IEC 62305 consists of the following parts, under the general title Protection against lightning:

- Part 1: General principles
- Part 2: Risk management
- Part 3: Physical damage to structures and life hazard
- Part 4: Electrical and electronic systems within structures

11.6 The lightning current is the source of damage. The following situations shall be taken into account, depending on the position of the point of strike relative to the structure considered:

- S1: flashes to the structure;
- S2: flashes near the structure;
- S3: flashes to the services connected to the structure;
- S4: flashes near the services connected to the structure.

11.7 Each source of damage may result in one or more of three types of damage:

- D1 Injury of living beings due to step and touch voltages
- D2 Physical damage (fire, explosion, mechanical destruction, chemical release) due to lightning current effects including sparking
- D3 Failure of internal systems due to Lightning Electromagnetic Impulse (LEMP)

11.8 The following types of loss may result from damage due to lightning:

- L1 Loss of human life
- L2 Loss of service to the public
- L3 Loss of cultural heritage
- L4 Loss of economic value

11.9 Damages & loss in a structure according to different points of strike of lightning:



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

<i>Point of strike</i>	<i>Source of damage</i>	<i>Type of damage</i>	<i>Type of loss</i>
Structure	S1	D1 D2 D3	L1,L4 L1,L2,L3,L4 L1,L2,L4
Near a structure	S2	D3	L1,L2,L4
Service connected to the structure	S3	D1 D2 D3	L1,L4 L1,L2,L3,L4 L1,L2,L4
Near a service	S4	D3	L1,L2,L4

11.10 In order to evaluate whether or not lightning protection of an object is needed, a risk assessment in accordance with the procedures contained in IEC 62305-2 shall be made. The following risks shall be taken into account, corresponding to the types of loss:

- R1: risk of loss of human life;
- R2: risk of loss of services to the public;
- R3: risk of loss of cultural heritage.

Protection against lightning is needed if the risk R(R1 to R3) is higher than the tolerable level RT
 $R > RT$

In this case, protection measures shall be adopted in order reduce the risk
 R(R1 to R3) to the tolerable level
 $R < RT$

11.11 The role of an air termination system is to capture the lightning discharge current and dissipate it harmlessly to earth via the down conductor and earth termination system. Therefore it is vitally important to use a correctly designed air termination system. BS EN/IEC 62305-3 advocates the following, in any combination, for the design of the air termination:

- Air rods (or finials) whether they are free standing masts or linked with conductors to form a mesh on the roof

- Catenary (or suspended) conductors, whether they are supported by free standing masts or linked with conductors to form a mesh on the roof

- Meshed conductor network that may lie in direct contact with the roof or be suspended above it (in the event that it is of paramount importance that the roof is not exposed to a direct lightning discharge)

11.12 Air terminals shall be mounted on top of buildings or structure as required. All air terminals shall be inter-connected with roof conductors, pipes, hand rails or any other metallic projection above the roofs shall also be bonded to the roof conductors. All metallic chimneys, ducts and the like above the roof of the structure shall be bonded to and form part of the air termination network. Vertical air termination points shall project at least 30 cm above the object on which it is fixed.

11.13 The three basic methods recommended for determining the position of the air termination systems are:

- The rolling sphere method
- The protective angle method
- The mesh method



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

11.14 Down conductors from air terminals or from roof conductors shall be routed as directly as possible to the test links on earth buses, with minimum bends.

11.15 Four protection levels have been determined based on certain parameters and each level has a fixed set of maximum and minimum lightning current parameters.

<i>LPL</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>Maximum current (kA)</i>	200	150	100	100
<i>Minimum Current (kA)</i>	3	5	10	16

11.16 Each Lightning Arrestor shall be connected to a separate electrode located as close as possible to it and within the fenced area for each set of arrestors. The two nos. electrodes for each set of arrestors shall be spaced about 5 meters apart so that they are all within the enclosing fence. Each of these electrodes shall be connected to the main earth grid.

11.17 All provisions regarding connections of conductors for equipment earthing system shall also apply to lightning protection system.

11.18 In corrosive atmospheres, plumbing metal for corrosion protection shall cover lightning finials or air terminals.

11.19 The layout and design of lightning protection systems for building extensions or new buildings and structures provided within existing station areas shall match the existing design.

11.20 All connections between the different parts of lightning protection systems and the connections to the earthing system must be performed in a manner such that the arising of chemical elements will be avoided.

11.21 Natural Components Of Collectors

Metal cladding, metal roof structures, metal components of roof Structures, gutters and railings may be considered as natural components of collectors.

The requirements of the standards, such as the following, have to be considered:

- Parts must be permanently conductively connected,
- Minimum thickness of the metal involved,
- Cross-sections of the parts.

Installations with metal casings need not to be fitted with collectors taking into consideration the above-mentioned minimum requirements.

Protective coatings or insulation between metal parts shall be electrically bridged.

11.22 Mesh Type Collectors

Buildings shall be provided with mesh-type collector lines. Protruding roof superstructures, such as ladders, chimney stacks, pipes, antenna mounting brackets, etc. and other metallic parts of buildings which are located near the roof (e.g. louvers of ventilation openings) must be directly connected to the collector lines.

This method is suitable where plain surfaces require protection if the following conditions are met:

- Air termination conductors must be positioned at roof edges, on roof overhangs and on the ridges of roof with a pitch in excess of 1 in 10 (5.7°).
- No metal installation protrudes above the air termination system.

Modern research on lightning inflicted damage has shown that the edges and corners of roofs are most susceptible to damage. The air rods should be spaced not more than 10 m apart and if strike plates are used as an alternative, these should be strategically placed over the roof area not more than 5 m apart.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Class of LPS	Mesh size (m)
I	5 x 5
II	10 x 10
III	15 x 15
IV	20 x 20

11.23 Collector Rods

Collector rods shall be used for roof superstructures featuring mechanically or electrically operated equipment, such as ventilators and non-conductive parts projecting from the mesh plane by 0.3 m. The angle of protection and a certain minimum distance have to be observed.

Outdoor electrical facilities for HVAC or other purposes not located in the protective area of earthed structures, installations or buildings, including exposed electrical equipment shall be protected by collectors.

Buildings with sheet metal roofs where the thickness of the sheet is smaller as the required value, the collector mesh must be equipped with collector rods of sufficient quantity and length to avoid lightning strokes in the sheet metal.

11.24 Down Conductors

Down conductors shall be selected in a manner such that there are several parallel current paths between the collector and the earthing system. The length of each down conductor is to be kept as short as possible.

Steel structures and steel columns of buildings may be used as down conductor, if the minimum sizes according to the standards are guaranteed. In each case the connections with the earthing system and collectors respectively must be visible and removable.

Starting from the corners of the structure involved, conductors should be distributed around the exterior as evenly as possible. They must be configured in such a way as to constitute the direct continuation of the collector. The minimum distance between conductors and doors windows and other apertures must be 0.5 m.

If not already connected with the collectors or with the internal potential equalisation, larger metal parts mounted in/on the building outer walls (e.g. frames of doors, ventilation louvers) shall be terminated on the down conductors.

The down conductor spacing should correspond with the relevant class of LPS :

Class of LPS	Typical Distances (m)
I	10
II	10
III	15
IV	20

All down conductors which are connected to the earthing system must be provided with an accessible isolating point for measuring purposes. For termination the grounding bars of grounding loops shall be used, preferably. No conductors are required for outdoor metal structures of adequate size.

11.25 Inadmissibly Short Distances



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Inadmissibly short distances between the lightning protection system and metal installations or electrical equipment shall be prevented. In the event of potential hazard due to flash-over or disruptive discharge caused by lightning, appropriate measures shall be taken.

Admissible distances between lightning protection systems and metal installations, electrical wiring and equipment shall be determined in compliance with the standards. This also applies to the use of special roof-mounted collectors.

11.26 Lightning Equipotential bonding

Equipotential bonding is simply the electrical interconnection of all appropriate metallic installations/parts, such that in the event of lightning currents flowing, no metallic part is at a different voltage potential with respect to one another. If the metallic parts are essentially at the same potential then the risk of sparking or flashover is nullified. Bonding can also be accomplished by the use of surge protective devices (SPDs) where the direct connection with bonding conductors is not suitable.

12.0 TESTS OF LIGHTNING PROTECTION SYSTEM

After erection of the earthing and lightning protection system all installations shall be tested in accordance with applicable regulations

The following tests shall be carried out, at least:

- Measures against corrosion protection and arising of chemical elements,
- Check of all connections,
- Measurements of earthing system resistance,
- Measurements of lightning protection system conductivity,
- Check of mechanical details,
- Compliance with specifications.

The aim of the tests is to ensure the proper function of the complete scope. The measuring results and the locations of the measuring points have to be indicated in respective drawings as a basis for future measurements.

13.0 DOCUMENTATION


Complete documentation shall be provided for the design, construction, testing, maintenance and repair of the earthing and lightning protection systems and their components.

The documentation shall be in English language.

The following drawings/documents shall be submitted for approval within 3 weeks of award of contract.

- a) Soil resistivity survey report
- b) Technical data sheets
- c) Earthing design calculations
- d) Lightning protection design calculations
- e) Earthing grid layouts
- f) Construction drawings
- g) Spare parts list
- h) Operation and maintenance manuals
- i) Test reports

The documents listed above shall be handed over for approval. Special attention has to be given to the fact, that documentation must be submitted with sufficient time allocated for approval prior to

 <p>Bhagyanagar Gas Limited</p>	<p style="text-align: center;">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p style="text-align: center;">VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------

manufacturing / assembly. The documentation has to be prepared in accordance with the relevant ISO standards. The final documentation shall be delivered on paper in sufficient number and with exception of the signed protocols in electronic form, also. The type of the electronic files and the number of copies shall be agreed with the Client.

After commissioning & testing of earthing system contractor shall submit the following document to Client/ PMC for As-Built status in hard copy (5 set) plus one soft copy.

- a) Soil resistivity survey report
- b) As built earthing grid layouts & earth electrode installations
- c) Construction drawings



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
ELECTRICAL INSTALLATION IN BUILDINGS**

SPECIFICATION NO.-



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

C O N T E N T S

SL. NO.	DESCRIPTION
	SCOPE
2.0	STANDARDS
3.0	GENERAL REQUIREMENTS
4.0	LIGHTING SYSTEM
5.0	OUTDOOR LIGHTING
6.0	CONDUIT SYSTEM
7.0	HAZARDOUS AREA
8.0	EQUIPMENT SPECIFICATIONS
9.0	TESTING AND COMMISSIONING
10.0	DOCUMENTATION



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 SCOPE

The intent of this specification is to define the requirements for the design, testing at manufacturer works, supply, erection, testing and commissioning of the electrical installation inside buildings, shelters, sheds etc.

2.0 STANDARDS

2.1 The work shall be carried out in the best workman like manner, in conformity with this specification, the relevant specifications/ codes of practice of the Indian Standard Institution, approved drawings and instructions of the Engineer-in-Charge or his authorized representative issued from time to time.

In addition the design, manufacturing, construction, installation, test and commissioning of illumination system shall be in accordance with the following codes and standards, at least. The latest revision of the publication referred to shall apply.

- i) Indian Electricity Act and Rules framed thereunder.
- ii) Regulations laid down by the Chief Electrical Inspector of the State, State Electricity Board.
- iii) Regulations laid down by the Factory Inspector of the State.
- iv) Any other regulations laid down by the local authorities.

IS: 418/ IEC 60598	-	Tungsten Filament Lamps for Domestic and Similar General Lighting Purposes/Luminaries
IS: 1112	-	Glass shells for general lighting service lamps
IS: 1944	-	Code of Practice for Lighting of Public Thoroughfares
IS: 2147/ IEC 60529	-	Degrees of protection provided by enclosures (IP Code)
IS: 2165/ IEC 60664	-	Insulation coordination for equipment within low-voltage systems
IS: 2206	-	Flameproof electric lighting fittings
IS: 2418	-	Tubular Fluorescent Lamps for General Lighting Service
IS-3646	-	Code of practice for interior illumination (Part-I, II & III)
IS: 4012	-	Dust-proof Electric Lighting Fittings
IS: 5571	-	Guide for Selection of Electrical Equipment for Hazardous Areas
IS: 6665	-	Code of practice for Industrial Lighting
IS: 16105	-	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources
IEC 60085	-	Thermal evaluation and classification of electrical insulation



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

2.2 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.3 In case any contradiction between various referred standards/specification/data sheets and statutory regulation etc the following order of priority shall be govern -

- i) Schedule of rates/Price schedule
- ii) Design Basis
- iii) Scope of work/Job specification
- iv) Data Sheet
- v) Standard specification
- vi) Codes & standard

3.0 GENERAL REQUIREMENTS

3.1 COMPONENTS AND EQUIPMENT

The Contractor has to take care that all components and equipment are selected considering easy maintenance, simple and quick diagnosis and long maintenance intervals. All components and equipment shall be designed for starting and continuous duty at rated load and under the given climatic conditions. Standard industrial components shall be used as far as possible. Components and equipment of same kind and type shall be selected for equivalent functions & shall have interchangeability.

3.2 TAGGING

All lighting fixtures shall receive the respective tagging plates, labels that indicate lamp type and lighting circuit etc, which have to be of extremely durable material, resistant against the environmental conditions. All equipment and installations must be tagged regarding the function and according to the drawings.

3.3 RATED DESIGN DATA

The electrical installation is to be designed for the following rated voltages:

Indoor Lighting: 230 V AC, 50 Hz, single phase (distribution should be in phase balance) Socket outlets: 230 V AC, 50 Hz, single phase

Power socket/Welding socket outlets: 415 V AC, 50 HZ, three phase and neutral


For extension of existing buildings, the available voltage level and distribution system must be considered.

4.0 LIGHTING SYSTEM

4.1 INDOOR GENERAL


Lighting installation for all indoor rooms and buildings, structural sheds, walk-ways, sheltered process installation etc includes the luminaries and all necessary switches, push buttons, switchboards, terminal boxes and installation facilities/accessories.

The lighting system inside and outside plant units are designed based on the desired illumination levels recommended by IS and the practices followed in industries, architectural arrangement, building dimensions including mounting height, environmental considerations, ease of

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

maintenance and reliability of the lighting distribution network.

- i) The distribution of lighting power supply for the individual areas shall be done at 415V, 3 phase, 4 wire bus system through Main Lighting Distribution Boards (MLDB) for the area. The MLDB shall be fed through a lighting transformer unless specified in TS. The outgoing feeders of the MLDB shall feed the required numbers of Sub Lighting Distribution Boards (SLDB) for lighting. Each SLDB shall receive power at 415V AC, 3 phase, 4 wire and distribute it into 240V, 1 phase circuits for connection to the lighting fixtures and 240V receptacles. The SLDB shall be located in the rooms, bays etc. covering the respective zone. The SLDB shall be located in the electrical rooms in the respective area.
- ii) The lighting fixtures in the plant/structural shed are fed from lighting panel and group controlled from SLDB as per construction drawing/Cable schedule and site requirement. Electrical cable between Main Lighting panel (MLDB) and SLDB shall be as per Cable schedule. Wiring between SLDB and lighting fixtures in the plant/structural shed shall be done by PVC insulated, PVC inner Sheathed, PVC outer sheathed, FRLS 3-core (phase, neutral and earth) un-armoured/armoured cable for hazardous areas & non-hazardous areas in GI conduits/Cable tray. GI conduit shall be supported at minimum distance of 1000mm. The lighting fixtures are grouped (3-5 fixtures or as per site condition and construction drawing) & controlled from SLDB through MCB's.
- iii) The minimum size of the cable for feeding power to SLDB or MCBDB having 32A incomer shall be 4x25sq.mm or as specified in TS/Cable schedule. Cable size for SLDB (or MCBDB) to light fittings shall be 3x2.5sq.mm. or 4x2.5sq.mm as per the configuration of fittings..
- iv) Wiring between switchboard and lighting fixtures in the building shall be done by PVC insulated copper conductor flexible wires in PVC conduit as specified. All joints of conductors in Switch board/JBS/Fitting shall be made only by means of approved Mechanical connectors (nylon/ PVC connectors). Bare or twist joints are not permitted anywhere in the wiring system. Cost toward mechanical connectors is deemed to have been included in wiring. In case of concealed wiring, single core, PVC insulated, stranded copper conductor wire of size 2.5 sq mm in MS conduit shall be used. For utility sockets, cable size shall be 4sq.mm
- v) The lighting layouts furnished by PMC in drawings shall indicate approximately locations of lighting fixtures. The electrical contractor shall determine the exact nos. of lighting fixtures according to lux level indicated else where in this specification with approval of the Engineer-in-Charge or his authorized representative at the site. The exact locations of each fixture in order to avoid interference with beams/columns, piping/ducts or other mechanical equipment and also with a view to obtain as uniform illumination as practicable, and to avoid objectionable shadows. Conduit run shown on drawing are only indicative. The contractor shall decide the conduit run according to site conditions as per directions of the Engineer-In-Charge.
- vi) Socket outlets in process areas shall be approximately 1200mm above finished grade and 300mm above grade in office area.
- vii) In electrical room, battery room buildings & corridors, twenty (20) percent but at least two (02) & In the control rooms, additionally thirty (30) percent but at least three (03) of the lighting fixtures per room & shall be supplied with power from Emergency DG set or Emergency Inverter or UPS power supply. In all other rooms, at least one lighting fixture per room shall be supplied with electric energy by the Emergency DG set or Emergency Inverter or UPS power supply. The wiring for these emergency lighting shall be in scope of contractor.
- viii) Fixtures shall be firmly supported from the structures, support clamps etc. may be bolted or welded to the existing steel work or metal inserts. In case of concrete structures, where metal inserts are not available, fixtures will be fixed to or supported from concrete surfaces with the help

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------


- of anchor fastener. In such cases special care shall be taken to see that anchoring is firm.
- ix) All hardware shall be galvanized or zinc passivated. Circuit cables shall be group cleared to structure by using galvanised strip clamps or run in cable trays wherever they are available. Spacers and cleats shall be of suitable size to accommodate the cables shall be got approved by Engineer-in-Charge before fixing from at site. For isolated structures lighting cables may be taken in underground G.I. pipes.
 - x) The cost for cable clamps, metal spacers, anchors bolts, etc. shall be deemed to have been included in the installation of cables.
 - xi) Contractor shall have close watch on the lighting drawings issued to him. Any discrepancy noticed between the figure given in the drawing and the actual requirement at site, shall be immediately brought to the notice of Engineer-in-Charge by the Contractor.
 - xii) All the fluorescent lighting wirings to be supplied under this contract shall consist of chokes, starters and capacitors. The fittings shall be high power factor type and shall be supplied with white light fluorescent tubes. All the lighting fittings shall be supplied complete with cable glands wherever applicable and the cost for the glands shall be deemed to have been included in the supply of fixtures.
 - xiii) Mounting details shall be indicated on the drawings. If specified on the drawings, a group of fluorescent lighting fixtures, which are to be mounted end to end, shall be fixed to mild steel cold rolled sections "Metsec channel". The entire assembly will then be fixed to the ceiling with necessary number of supports as required to reduce the deflection. The 'Metsec' channel shall run continuous in suitable sections from one end to other end of wall. The complete channel shall be spray painted, with approved colour as per the directions of Engineer-in-Charge. Nylon tape & buttons shall neatly bunch all wires inside channel.
 - xiv) Fixtures shall be firmly supported from the structures. Support clamps etc., may be bolted welded to the existing steel works or metal inserts. In case of concrete structures minimum two numbers metallic anchor fasteners of approved size shall support fixtures. All supports shall be thoroughly cleaned and painted in an appropriate colour to suit the fixture.
 - xv) In case of false ceilings employing minimum tee grid system, fixtures shall be supported from true ceiling. Exact locations of fixtures shall be supported from true ceiling. Exact locations fixtures shall be finalized in consultation with air-conditioning contractor and as indicated on Architectural drawings. Wiring above false ceilings shall not be left loose and shall be supported along the structures/ceilings. Wiring above false ceiling shall be on surface and below false ceiling it shall be concealed. To facilitate easy maintenance 'Looping back system of wiring shall be followed throughout. Accordingly supply tapping and other interconnections are made only at fixtures connector blocks or at switch boards. Intermediate junction boxes shall be used for wire pulling as inspection boxes.
 - xvi) All wires in conduit shall be colour coded as specified/as per IS. Each circuit shall have independent phase neutral and earth wire. Unless otherwise specified, insulated conductors ac supply and dc supply shall be bunched in separate conduits.

4.2 INDOOR LIGHTING

For the purpose of illumination of electrical rooms (Buildings/Indoor areas), the lighting system shall be divided into the following lighting sub-systems:

4.2.1 Control rooms

The illumination of control room housing PLC, HMI, VFD, UPS, Soft starters etc will be provided

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

with Decorative mirror optic luminaire for recessed mounting with energy efficient CFL 2x36W or Decorative type diffused optics for recessed mounting LED TL.

4.2.2 Electrical rooms

The illumination of electrical room housing MCC, PDB, MLDB and other distribution boards shall be provided with Surface mounted / Suspended luminaires suitable for T5 lamps 2x28 W or Surface mounted / Suspended luminaires suitable for LED.

4.2.3 The illumination system shall be designed as per IS:3646-1992. The level of illumination, type of fittings, maintenance factor to be considered is as given below:

Area	Type of Light Fittings & Lamps	Lux level	MF
Control rooms	Decorative mirror optic luminaire for recessed mounting with energy efficient CFL 2x36W OR Decorative type diffused optics for recessed mounting LED of 40W TL OR equivalent.	300	0.75
Electrical rooms having PCC, PDB, MLDB etc. without false ceiling	Surface mounted / Suspended luminaires suitable for T5 lamps 2x28 W OR Surface mounted / Suspended luminaires suitable for LED of 40W OR equivalent.	200	0.7
Battery Room	General purpose batten luminaire with energy efficient T5 lamps 2x28W OR General purpose batten luminaire with LED of 40W OR equivalent.	100	0.6
Transformer Room	General purpose batten luminaire with energy efficient T5 lamps 2x28W OR General purpose batten luminaire with LED of 40W OR equivalent.	100	0.6
Civil Staircases of plant buildings	General purpose batten luminaire with energy efficient T5 lamps 2x28W OR General purpose batten luminaire with LED of 40W OR equivalent.	100	0.6



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Toilets	General purpose batten luminaire with energy efficient T5 lamps 1x28W OR General purpose batten luminaire with LED of 20W OR equivalent.	100	0.6
Pump Houses (near equipment / metering area), structural sheds	Industrial well-glass integral type luminaire suitable for 70W HPSV lamps OR Industrial well-glass integral type luminaire suitable IP66 and IK08 protection for LED of		

The illumination level and the type of luminaries in the various rooms must ensure a smooth and good illumination according to the demand, application and lay-out of the rooms.

4.2 LUMINARIES AND ACCESSORIES

All the luminaires will be designed, manufactured and tested in accordance with the Indian Standards as far as they are applicable.

All the luminaires will be industrial type. Specification for the various types of sodium vapour and fluorescent fittings mentioned in the schedule of quantities will be followed. All the lighting fixtures will be complete with all parts along with lamps/tubes, control gears and accessories for installation and efficient performance whether specifically mentioned in the specification or in the schedule of items or not.

The luminaries provided shall be suitable for standard lamps, preferably 11 W, 18 W, 25 W, 36 W or higher for fluorescent lamps/LED lights (as per Scope of work/ detail engineering) and 70 W, 150 W, 250 W or 400 W HPMV/HPSV lamps or LED lights as specified in Scope of work & design basis. All luminaries must be fully equipped with starter and power factor compensation.

FLUORESCENT FITTINGS

4.2.1 DECORATIVE FLUORESCENT LIGHT FITTING

Decorative type light fitting suitable for energy efficient CFL lamps and T5 lamps/ LED Lamps, mirror optic luminaries for recessed mounting. Housing shall be made of CRCA sheet steel, epoxy polyester powder coated accommodating all electrical accessories pre wired upto a terminal block. It shall have optimum glare control and shall be aesthetically appealing with distinguished looks.

4.2.2 INDUSTRIAL TYPE FLUORESCENT LIGHT FITTING

The fitting will have channel and reflector made of CRCA sheet steel with white cover plate. Channel and reflector will be finished with light Grey stove enamelled outside and white stove enamelled inside. The fitting will be complete with all electrical accessories like polyester filled ballast, starter, spring loaded rotor lamp holders, starter holder, power factor improvement capacitor to improve the power factor upto 0.95 etc. All the fluorescent tube lights fixtures shall have electronic ballast having third harmonic distortion less than 6% and total harmonic distortion less than 12 % .

All types of fluorescent fittings will be suitable for mounting on wall/ceiling/conduit suspension.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Power factor improvement
Power factor of all the light fittings shall be improved so that it is not less than 0.90. Power factor shall be improved by providing capacitor banks with discharge resistor in the light distribution or by providing capacitors with individual fittings.

4.3 SOCKET OUTLETS

i) Power Socket Outlets/Welding receptacles

Power socket outlets shall be three phases, neutral and earth in compliance with IEC/IS-standard.

- 415V, 100 A/ 63A, 3 pole load break switch
- 3 phase and one earth pin socket
- Switch socket interlocked so as to prevent insertion or withdrawal of plug when switch is "ON".
- Facilities for terminating two cables of 3.5 x 50/70 sq. mm aluminium cables.
- All the switch socket outlet shall be fed from PDB directly.

Power socket outlets shall be provided in sufficient quantity in all workshops, pump houses, structural sheds, electrical rooms etc as per drawings & instruction of Engineer-in Charge.. Each Power socket outlet must be protected by means of a dedicated miniature circuit breaker located in the distribution boards.


Welding switch socket outlets shall be provided at every 60m distance in conveyer galleries and atleast one at every working platform of junction houses. The number of welding socket outlets for main technological plant units shall be decided based on requirement, approach etc. Generally the socket outlets shall be provided in such a manner so that using 30m flexible cable with welding set, total plant area can be covered. Upto Three switch socket outlets can be looped per feeder circuit.

ii) Industrial Socket Outlets

Socket outlets shall be single phase, neutral and earth according to IEC/IS. Socket outlets shall be installed in sufficient number in each room as per tender drawings enclosed and instruction of Engineer-in-Charge. Socket outlets shall be protected by means of miniature circuit breakers as per construction drawing. Socket outlets designed for supplying dedicated consumers e.g. AC, boilers, heaters, refrigerators, etc.

240V SWITCH SOCKET OUTLET

1.0	Type	:	1 pole, 3 pin with third pin earthed industrial type receptacles . non-reversible, metal-clad, dust proof, industrial type suitable for horizontal insertion.
2.0	Rating	:	240 V AC , 15A,
3.0	Construction	:	Metal clad gasketted construction, weatherproof All socket outlets will be supplied with heavy-duty type plug and cap

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

with chain.


4.0	Isolation Switch	:	rotary type switch mounted flush in the socket outlet box. The isolating switches will be manually operated industrial type of category AC 22.
5.0	Protection	:	Operating handle of the rotary switch will be fixed in such a manner that it will not be possible either to insert or withdraw the plug without switching off the supply.
6.0	Cable entry	:	Suitable for cable entry through 20mm dia. conduit.
7.0	Mounting	:	Wall / column mounting
8.0	Inscription	:	Inscription plate will be provided indicating the voltage and current rating of the switch socket outlet.
9.0	Miscellaneous	:	In hazardous area, flame proof switch socket outlet will be provided.

iii) Receptacles/Convenience Socket Outlets

5A/15A combination type receptacles manufactured in accordance with IEC/IS: 1293 shall be used with the third terminal connected to the earth. All receptacles shall be provided with a switch mounted on the same enclosure but shall be a separate unit to facilitate replacement by part. Flush mounting type receptacles shall be used in areas where concealed wiring has been adopted and surface type shall be used in other areas.

Transformer for 24V AC Sockets :-

1.0	Type	:	Dry type Step-down transformer Air-cooled
2.0	Rating	:	Minimum 2500VA
3.0	Primary / Secondary voltage	:	240V /26.5 V AC , single-phase
4.0	Construction	:	The transformer shall be enclosed in industrial wall mounting stainless steel (2 mm thick) box having separate chambers for the transformer, incoming and outgoing MCB's.

 Bhagyanagar Gas Limited	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
--------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

5.0 Cable entry : Suitable knock-outs shall be provided at the top and bottom for.

6.0 No. of winding : Two winding

7.0 Protection : SPN MCB's on primary and secondary side incorporating overload and short circuit releases.

8.0 Utility : Power supply to 24V repair network

9.0 Location : On structural platforms

1.0	Type	:	2 pole, 3 pin with third pin earthed industrial type receptacles
2.0	Rating	:	24 V AC , 5A
3.0	Construction	:	Metal clad gasketed construction, weatherproof
4.0	Cable entry	:	Suitable for cable entry through 20mm dia. conduit.
5.0	Mounting	:	Wall / column mounting


iv) Switches

Switches, manufactured in accordance with IS: 3854 shall be used. Switches in areas where concealed wiring has been adopted shall be flush mounting piano type unless otherwise specified. The switches shall be Shock proof, Fire retardant & Dust proof with more switching operations. Electronics type fan regulator shall be used for ceiling fans. Design and models of the regulator shall be same as that of switches.

Outlet Boxes

Control Room Switchboard

1.0	Location	:	Control room for controlling the lighting fixtures
2.0	Type	:	Flush mounted type
3.0	Construction	:	Fabricated from 14 SWG MS sheet with 6mm thick bakelite cover Shall have conduct knockouts on the sides.
4.0	Switch mechanism	:	Modular switches shall be provided
5.0	Power source	:	The switchboards shall be fed from SLDB of respective area.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

240 V SINGLE/ DOUBLE POLE SWITCHES

1.0	Application	:	The switches are intended for controlling lighting circuits
2.0	Type	:	Weather and dustproof and industrial type
3.0	Design	:	The rotary or toggle switches provided will be of sturdy design
4.0	Standard	:	As per IS : 6875 (Part-3) - 1980
5.0	Housing	:	The unit will be housed in cast iron or cast aluminium having gasketted, screwed front cover plate, fixing lugs suitable provision for terminating conduit/cable at the bottom or sides as specified.
6.0	Mounting	:	DIN Channel mounting . Single phase MCBs mounted adjacent to each other

connected to different phases will be provided with adequate insulated phase barriers

7.0 Terminal Suitability : Terminals suitable for aluminium conductor cables.

5.0 OUTDOOR LIGHTING


For outdoor lighting refer specification for outdoor lighting-.

6.0 CONDUIT SYSTEM

Surface or concealed conduit system of wiring shall be adopted, as specified in the drawings. Suitable pull boxes or inspection type fittings will be used to facilitate drawing of wires.

SURFACE WIRING

6.1 Only threaded type GI conduit fittings shall be used. Pin Grip type or clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed with bakelite bushings.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------


- 6.2 In order to minimize condensation of sweating inside the conduit system, all cables shall be properly drained & sealed with non hardening silicon compound in such a manner so as to prevent entry if insects.
- 6.3 The outer surface of the GI conduit pipes, including all accessories forming part of the conduit system, shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, bare threaded portion of conduit pipe shall not be allowed unless such bare threaded portion is treated with anti corrosive preservative or covered with approved plastic compound.
- 6.4 Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side.
- 6.5 Conduit pipes shall be fixed by 16 gauge G.I. Saddles on 25x6 mm G.I. Saddle bars in an approved manner at intervals of not more than 500 cms vertical support & 1000mm for horizontal support. Saddles shall be fixed on either side of couplers, bends or similar fittings, at a distance of 30 cm from the center of such fittings. The cost of saddle bars, FLP junction box, saddles, clamps, etc. Shall be deemed to have been included in the installation of conduits.

CONCEALED WIRING

- 6.6 Where of the slab. The Contractor shall coordinate his work with other agencies involved in the civil works in such a way, that the work of these other agencies is not hampered or delayed because of any section on his part. Vertical conduit runs shall be made either through columns or chases prepared in the walls. Contractor shall fill these chases or any other openings made by him after completing. During Installation, care shall be taken to see that adequate covers are provided to the conduits. If required, conduits run may be concealed in the floor for low-level receptacles and exhaust fans. Contractor shall submit as built conduit layout drawing.
- 6.7 Wiring for exhaust fans shall be terminated at wall/receptacles and the connection from ceiling roses/ receptacles to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires.
- 6.8 After erection, the entire conduits system shall be tested throughout, for mechanical and wiring in conduit shall be tested for electrical continuity and shall be permanently connected to earth by means of approved type earthing clamps, in accordance with Indian Electricity Rules.

7.0 HAZARDOUS AREA

- 7.1 Wiring in hazardous area shall be done by minimum 2.5 mm² Copper Conductor armoured, PVC insulated, FRLS cables.
- 7.2 Correct type of lighting equipment (fixtures and JBs etc.) as specified in the drawing, shall be installed for the particular classified zone 1 (Class I Div. I) and Zone 2 (Class I Div.II) locations as specified in design basis.
- 7.3 The wiring in hazardous area shall be carried out by highly skilled wireman with due regard for perfect terminations. The terminations in the junction boxes and the lighting fittings shall be done so as not to work loose due to vibrations. After the terminations are made the cover of the junction boxes and the lighting fittings shall be closed to make the complete fittings weatherproof. In fixtures having double cable entries, both the entries shall be used for looping in and looping out connection. Thus avoiding the use of a separate junction box.
- 7.4 Suitable size double compression nickel plated brass cable glands (Approved by CMRI as suitable for flameproof area) shall be provided for cable entry/exit to any of the flame proof

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

apparatus.

- 7.5 The rate quoted shall include the cost of accessories required like FLP JB's, saddles, consumables etc for supply and installation of complete wiring system.

8.0 EQUIPMENT SPECIFICATIONS

All materials, fittings and appliances to be supplied by the contractor shall be of the best quality and shall conform to the specifications given hereunder. The equipment shall be manufactured in accordance with the latest revision of respective Indian Standards. In the absence of any specifications, Material samples shall be brought to site by Contractor and get it approved by Engineer-in-Charge or his authorized representative before installation.

Each circuit phase/neutral shall be given ferrule numbers. Complete wiring inside the panel shall be neatly bunched with PVC tape & button. All cables entries shall be as marked in the schedule. Cables glands for PVC insulated armoured cables of sizes as specified on panel schedule shall be provided for the incoming cables of all surface mounted panels. For the outgoing circuits of these panels cable glands or conduit entry shall be provided as specified on panel schedule. Conduit entry shall be provided for the incoming and outgoing circuits of all flush mounted panels. All metal surfaces shall be cleaned free of rust given a coat of red-oxide primers and finished with 2 coats of approved paints.

8.1 Outlet Boxes

Outlet boxes for sockets, switches, fixtures and fan regulators etc shall be of minimum 16 gauge & M.S. Sheet 3" deep. Junction/Outlet boxes shall be used in roof slab where concealed wiring has been adopted. Front cover plate shall be of sheet steel in areas where surface wiring has been adopted. For concealed wiring the front cover plate shall be of Formica or approved equivalent with colour to suit the walls. Outlet boxes shall be electro-galvanized after fabrication. Cover plate shall be fixed by Nickel plated brass screw and suitable C.P. brass cup washers. Engineer-in-Charge shall approve samples of these.

8.2 Conduit and Fittings

GI conduits-

GI conduits shall be of galvanized iron, rigid, screwed type. The internal bore of all conduits shall be smooth & free from burrs. Conduits upto 32mm dia shall be 1.6 mm thick & conduits above 32 mm shall be 2mm thick.

PVC conduits-


PVC conduits shall be used in concealed wiring of 1.8 mm thickness.

For surface wiring GI conduit (in industrial buildings) and ERW conduit (in non industrial buildings) shall be used.

Point wiring shall include the length of conduits (GI & PVC) including all other accessories like joints, bends, junction/pull boxes etc as required for illumination & wiring.

Care shall be taken to see that all conduit ends have no burrs and ends are neatly reamed to avoid damage to wires. All metal conduit accessories shall be only of threaded type. Pin grip or clamp type accessories are not acceptable. Samples of these shall be furnished for approval by Engineer-in-Charge at site, before installation.

8.3 Wires

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Wires shall be PVC insulated 660/1100 Volts grade as per IS: 1554. Conductor shall be stranded copper and size shall be Min. 2.5 mm² for lighting and Min. 4 mm² for power socket and industrial socket for Air Conditioner circuits. Red/ Yellow/ blue wires for phases black wire for neutral and green wire for earth shall be used. Wiring in conduits without colour coddling is not acceptable. Engineer-in-Charge shall approve make and samples of this before lying.

9.0 TESTING AND COMMISSIONING

Lighting installation shall be tested as per the instruction of Engineer-in-Charge and shall include but not be limited to the following:

- 9.1 Measure the insulation resistance of each circuit without the lamps (load) being in place and it should not be less than 500,000 ohms to earth.
- 9.2 Current and voltage of all the phases shall be measured at the lighting panel bus bars with all the circuits switched on with lamps, if required load shall be balanced on the three phases.
- 9.3 Check the earth continuity for all sockets outlets. A fixed relative position of the phase and neutral connections inside the socket shall be established for all sockets.
- 9.4 After inserting all the lamps and switches on all the circuits minimum and maximum illumination level should be measured in the area.
- 9.5 Ensure switch ON/OFF control for each point (light/fan/socket) is only on live side.
- 9.6 Contractor shall submit and forward the test reports of complete electrical installation in buildings to Engineer-in-Charge.

10.0 DOCUMENTATION


Complete documentation shall be provided for the design, manufacturing, testing, commissioning, start-up, operation, maintenance and repair of the electrical building installation and its components. The final documentation shall include the following documents and drawings (minimum requirements):

- The following documents shall be submitted along with the offer:
- a) Recommended list of two years operation and maintenance spare.

The following drawings shall be submitted for approval within 3 weeks of award of contract.

- a) Data sheets of components
- b) Single line diagrams
- c) Wiring diagrams
- d) Cable lists
- e) Cable calculations
- f) Cable route drawings within buildings
- g) Installation details
- h) Type test reports of various equipments

The documents listed above shall be handed over for approval. Special attention has to be given to the fact, that documentation must be submitted with sufficient time allocated for approval prior to manufacturing/assembly.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Documentation has to be prepared in accordance with the relevant ISO standards. The final documentation shall be delivered on paper in sufficient number and in electronic form, too.




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
OUTDOOR LIGHTING**

SPECIFICATION NO. -

 Bhagyanagar Gas Limited	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
--------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

C O N T E N T S

SL. NO. DESCRIPTION

- 1.0 SCOPE
- 2.0 STANDARDS
- 3.0 ENVIRONMENTAL CONDITIONS
- 4.0 GENERAL REQUIREMENTS
- 5.0 DESCRIPTION OF LIGHTING SYSTEMS
- 6.0 RATED DESIGN DATA
- 7.0 LIGHTING POLES.
- 8.0 LIGHTING FIXTURE FOR HAZARDOUS AREA
- 9.0 HIGH MAST
- 10.0 LIGHTING FIXTURES
- 11.0 TESTS
- 12.0 DOCUMENTATION



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 SCOPE

- a. The intent of this specification is to define the requirements for the design, supply, installation, erection, testing and commissioning of the outdoor lighting within the station area.
- b. **Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:**
 1. **Type of areas to be illuminated, hazardous or non-hazardous classification for suitability of installation of light fittings.**
 2. **Type of Light fittings and its quantities in line with SOR.**
 3. **Conventional type Well glass luminaire/ industrial grade LED luminaire**
 4. **Lux levels other than mentioned in GS or project specific details, if any.**

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 STANDARDS

The work shall be carried out in the best workman like manner, in conformity with this specification, the relevant specifications/ codes of practice of the Indian Standard Institution, approved drawings and instructions of the Engineer-in-Charge or his authorized representative issued from time to time.

In addition the design, manufacturing, construction, installation, test and commissioning of illumination system shall be in accordance with the following codes and standards, at least. The latest revision of the publication referred to shall apply.

- i) Indian Electricity Act and Rules framed thereunder.
- ii) Regulations laid down by the Chief Electrical Inspector of the State, State Electricity Board.
- iii) Regulations laid down by the Factory Inspector of the State.
- iv) Any other regulations laid down by the local authorities.

IS: 418/ IEC 60598	-	Tungsten Filament Lamps for Domestic and Similar General Lighting Purposes/Luminaries
IS: 1112	-	Glass shells for general lighting service lamps
IS: 1944	-	Code of Practice for Lighting of Public Thoroughfares
IS: 2147/ IEC 60529	-	Degrees of protection provided by enclosures (IP Code)



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

IS: 2165/ IEC 60664	-	Insulation coordination for equipment within low-voltage systems
IS: 2206	-	Flameproof electric lighting fittings
IS: 2418	-	Tubular Fluorescent Lamps for General Lighting Service
IS-3646	-	Code of practice for interior illumination (Part-I, II & III)
IS: 4012	-	Dust-proof Electric Lighting Fittings
IS: 5571	-	Guide for Selection of Electrical Equipment for Hazardous Areas
IS: 6665	-	Code of practice for Industrial Lighting
IS: 16105	-	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources
IEC 60085	-	Thermal evaluation and classification of electrical insulation

- 2.1 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.
- 2.2 In case any contradiction between various referred standards/specification/data sheets and statutory regulation etc the following order of priority shall be govern -
- i) Schedule of rates/Price schedule
 - ii) Design Basis
 - iii) Scope of work/Job specification
 - iv) Data Sheet
 - v) Standard specification
 - vi) Codes & standard

3.0 ENVIRONMENTAL CONDITIONS

The outdoor lighting shall be suitable for continuous operation at rated load under the climatic and environmental conditions defined in the "Design Basis". The various equipment shall be appropriate for outdoor installation.

4.0 DESCRIPTION OF LIGHTING SYSTEMS

The lighting system inside and outside plant units are designed based on the desired illumination levels recommended by IS and the practices followed in industries, architectural arrangement, building dimensions including mounting height, environmental considerations, ease of maintenance and reliability of the lighting distribution network.

4.1 OUTDOOR LIGHTING

The light fittings shall be complete with all accessories like electronic ballast, reflector etc. External area lighting including street/road lighting / tower lights shall be fed from MLDB through separate SLDB located at suitable places. Automatic switching ON/OFF of these circuits shall be done through



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

timers. Flood light towers shall be fed through 415/240V, 3 phase, 4 wire circuit with individual fittings distributed at 240V, single phase, with control and protection located at bottom of each tower. Rewireable fuse in a sheet steel box shall be provided near each fitting to facilitate removal of lamp in off position.

In high bays walkway shall be provided for maintaining light fittings. At other places suitable ladder/platform/approach shall be provided for maintaining/replacement of light fittings.

For the purpose of illumination of outdoor areas within stations, the lighting system shall be divided into the following lighting sub-systems:

4.1.1 Station area lighting

The station area lighting will be provided by high Mast, Flood Light & Pole/Bracket Mounted Lighting fixture as per Schedule of rates.

The lighting shall mainly consist of flood light and street light fixtures (Pole/Bracket Mounted) equipped with high pressure discharge lamps (HPMV/HPSV/MH) or LED lamps mounted on poles and if necessary, with Pole/Bracket Mounted fixtures fluorescent lamp/LED light may be used as per particular requirement.

As far as possible, the maximum horizontal illumination levels of the lighting shall be near the equipment located in outdoor area.

4.1.2 Shed/Shelter lighting

The Shed/Shelter area lighting will be provided by Industrial High/Medium/Low Bay Integral/non-integral fixture, Industrial Integral/non-integral well glass fixture, Industrial T5 fixture as per Schedule of rates.

The lighting fixtures shall mainly consist of high pressure discharge lamps (HPMV/HPSV/MH).

As far as possible, the maximum horizontal illumination levels of the lighting shall be near the equipment located in Shed/Shelter.

4.1.3 Road/street and parking area lighting

The road/street and parking area lighting will be provided for all roads and parking areas. The lighting shall mainly consist of Pole/Bracket mounted street lighting fixtures, equipped with high pressure discharge lamps (HPMV/HPSV) or LED lights mounted on poles, if necessary, with Pole/Bracket Mounted fixtures fluorescent lamps/LED lights may be used as per particular requirement. The maximum horizontal illumination level of the lighting shall be in the middle (axis) of the roads and parking areas, respectively.

4.1.4 Entrance lighting

The entrance lighting will be provided for all doors and gates all buildings. The entrance lighting shall mainly consist of wall mounted lighting fixtures, equipped with fluorescent lamps/LED lights.

4.1.5 Periphery/Fence lighting

The Periphery/fence lighting will be provided for the boundary of stations. The lighting shall mainly consist of pole/bracket mounted flood light equipped with high pressure discharge (HPMV/HPSV) lamps or street light or T5 fixture with fluorescent lamp or pole/bracket mounted LED lights. The poles of



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Periphery/Fence lighting have to be installed inside the boundary or on the wall for bracket mounted fixture. Illumination level and the design of the devices of Periphery/Fence lighting must be in accordance with the relevant IS/IEC requirements.

4.1.6 Post top lantern

Two no. of post to lantern with CFL/LED luminary shall be provided at Main Gate of terminal.

4.1.7 Emergency solar street light

A stand alone dusk-dawn solar photovoltaic street lighting system comprises of solar PV module, CFL/LED lamp, lead acid battery, control electronics, Inter-connecting wire/cables, Battery box, Module mounting hardware, GI-Pole etc.

4.1.8 The illumination system shall be designed as per IS:3646-1992. The level of illumination, type of fittings, maintenance factor to be considered is as given below:

Area	Type of Light Fittings& Lamps	Lux level	MF
Station area lighting	Industrial well-glass integral type luminaire suitable for 70W HPSV/HPMV/MH lamps OR Industrial well-glass integral type luminaire suitable IP66 and IK08 protection for LED of 30W/40W OR equivalent.	30	0.6
Platforms near technological areas	Industrial well-glass integral type luminaire suitable for 70W HPSV/HPMV/MH lamps OR Industrial well-glass integral type luminaire suitable IP66 and IK08 protection for LED of 30W/40W OR equivalent.	50	0.6
Shed/ shelter/ DG	Industrial well-glass integral type luminaire	150	0.6

Area	Type of Light Fittings& Lamps	Lux level	MF
Shed lighting	suitable for 70W HPSV/HPMV/MH lamps OR Industrial well-glass integral type luminaire suitable IP66 and IK08 protection for LED of 30W/40W OR equivalent.		
Main Technological/ Operational areas	High bay/Medium bay integral type light fittings suitable for 400W /250W/150W/70W HPSV/HPMV/MH lamps OR High bay/Medium bay integral type light fittings suitable for bay upto 15m high with LED 140 NW/CW PSD wide beam /narrow beam as per requirement OR Equivalent	50	0.6
Pump house/ Compressor/ Exhauster houses/ Conveyor houses	Industrial well-glass integral type luminaire suitable for 150W/70W HPSV/HPMV/MH lamps OR Industrial well-glass integral type luminaire suitable IP66 and IK08 protection for LED of 30W/40W OR Equivalent	100	0.6



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Flood lighting	Weather proof non integral type (integral type in case of high mast) flood light fittings suitable for 1x250/400W HPSV lamps OR equivalent.	50	0.5
Street light Fittings	Street light luminaire suitable for 150/250 W HPSV HPMV/MH lamps of 150/250 W OR equivalent.	30-15	0.6
Parking areas	Industrial well-glass integral type luminaire suitable for 70W HPSV/HPMV/MH lamps OR High bay/Medium bay integral type light fittings suitable for bay upto 15m high with LED 140 NW/CW PSD wide beam /narrow beam as per requirement OR Equivalent	15	0.6
Entrance lighting	Surface mounted / Suspended luminaires suitable for T5 lamps 2x28 W OR Surface mounted / Suspended luminaires suitable for LED of 40W OR equivalent.	30-40	0.6
Periphery lighting	Industrial well-glass integral type luminaire suitable for 70W HPSV/HPMV/MH lamps Industrial well-glass integral type luminaire suitable IP66 and IK08 protection for LED of 30W/40W OR equivalent.	5-10	0.6
Aviation obstruction	Aviation obstruction light fittings, flame retardant type consisting of multi ultra high intensity 60 mscp LED module, without flashing module, steady in red colour, having omni directional capability and shall be suitable to deliver maximum light output in the zone between 70° above and 10° below the horizontal with a maximum of condition at 20° above the module -240 V OR equivalent	As required	

4.1.9 RATED DESIGN DATA

The outdoor lighting shall be designed on basis of the following minimum requirements:

a) Average of illumination levels

- Station areas 25-30 lx
- Roads, streets 15 - 20 lx
- Parking areas 15 lx
- Entrances 30-40 lx
- Fences 5 – 10 lx

b) Uniformity of illumination levels

- Station areas 1: 3
- Roads, streets 1: 6
- Parking areas 1: 6
- Fences 1: 5

The uniformity of illumination levels means the ratio between the lowest and the highest



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

measured horizontal illumination level in the reference area.

The outdoor lighting shall be fed with a voltage of 3 x 415V/1x230 V, 50 Hz, or with other voltages if supplied from existing switchboards.

MB Lal committee recommended lux level for outdoor area shall be followed for various terminal system field area / tank access areas etc.

5.0 LIGHTING POLES

For specification of lighting poles please refer Annexure-I.

6.0 LIGHTING FIXTURE FOR HAZARDOUS AREA

Refer specification for hazardous area fixtures.

7.0 HIGH MAST

Refer specification for High Mast.

8.0 LIGHTING FIXTURES

8.1 Flood Light Fixture

The flood light fixtures shall consist of the following main parts:

- High pressure die-cast aluminium body and front cover frame, polyester powder coated (IP65)
- Electro polished, anodized and sealed aluminium reflector
- Lamp holder with adjustable for centralising the lamp within the fixture
- Heat resistant toughened front glass
- Hinged front cover
- Non-integral gear
- Galvanized steel stirrup with protractor for setting of elevation angle.

The flood light fixtures shall be equipped with HPMV/HPSV/MH/LED lamps of sufficient wattage to meet the lux level requirements as per the Design Basis/ Scope of work.

8.2 Street Light Fixture

The street light fixtures shall consist of the following main parts:

- Die-cast LM6 aluminium housing, polyester powder coated (IP65)
- Hydro formed, one piece reflector in high purity aluminium, anodised and electrochemically brightened
- A toughened heat resistant clear glass fixture.
 - Integral/Non-integral gear with power factor improvement capacitor as per Scope/Design Basis.

The flood light fixtures shall be equipped with HPMV/HPSV/MH/LED lamps of sufficient wattage to meet the lux level requirements as per the Design Basis/ Scope of work.

LED lights/ Mercury Vapour or MH lamp used for lighting as per Scope of Work /Design basis, unless otherwise specified Sodium vapour lamps may be used.

The fixtures shall be specially protected against damage in case of storms/heavy wind flow.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

8.3 Street Lighting Fixture with CFL/LED Lamps

The lighting fixtures with fluorescent lamps shall consist of the following main parts:

- Canopy of CRCA MS, epoxy powder coated (IP54)
- Integral/Non-integral gear with power factor correction, steel column bracket for side entry or brackets for wall/structure mounting.

The lighting fixtures shall be equipped with CFL/LED lamps up to 1 x /2x 18W/36W etc (As specified in Scope of Work or Design Basis)

8.4 CONTROL GEAR, LAMP & ACCESSORIES

• Lamps

Sodium vapour lamps will be suitable for universal burning position. The characteristics of the lamps will be in line with the relevant Indian Standards. The outer bulbs will be elliptical heat resistant type, evacuated to minimise heat losses and coated with light diffusion film for pleasing colour discharge. The lamp will be provided with corrosion resistant, nickel-plated screw base.

• Ballast's

All ballast's will be of proven design and capable of delivering long trouble free service. The ballast's will be made up of low loss silicon with steel lamination and will be wound with polyester-based super enamelled copper wire. The ballast will be polyester filled and able to dissipate the heat efficiently so as to keep the temperature rise well within the limits specified in the IS.6616-1972. The ballast will be provided with tapping at 200,220 and 240 volts and will be suitable for HPSV lamps.

• Capacitors

Capacitors will have element wound from layers of high purity Aluminium foils laid over the two faces of capacitor paper. The Aluminium cylindrical case containing the elements will be dried under high vacuum and impregnated before being sealed. The solder type lug terminals will be mounted over porcelain insulators at the sealed end and the capacitor will conform to IS: 1569. The value of capacitance will be chosen as to raise the power factor of burning lamps to above 90%.

• Igniters and Starters.

Igniters for HPSV lamps will be of proven design and capable of delivering long trouble free operations. The igniter and starters will be suitable for tropical condition and conform to IS: 2215-1968.

• Lamp and Starter Holders

Lamp and starter holders will have good spring contacts and of well tried out design. The spring contact will be such as to prevent disconnection due to vibration during cleaning. They will also have facility for easy removal.

8.5 Cables and Grounding

The lighting cables shall be three phase for connection to single pole fixture. The connection shall take into consideration the load balance on the three phase system. The cross section must be determined according to the current capacities and the voltage drops. The minimum cross section shall be 4 mm² for Cu cable & 6 mm² for Al cable. Separate grounding connection of the lighting poles and lighting towers with the grounding network shall be provided. Cables installations and the grounding shall be in accordance with specification "Cable Laying" and "Earthing and Lightning Protection", respectively.

9.0 TESTS

After erection of the outdoor lighting system all electrical installations shall be tested in accordance with applicable IEC/IS regulations. The horizontal lighting levels shall be checked by the Contractor in



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

the presence of the Client/Consultant. The test results of the lighting level measurements shall be recorded in a respective report by the Contractor. The checking method shall be worked out by the contractor prior to tests and shall be subject to the Client's approval. The aim of the tests is to ensure the proper function of the complete scope.

10.0 DOCUMENTATION

Complete documentation shall be provided for the design, manufacturing, testing, commissioning, start-up, operation, maintenance and repair of the outdoor lighting and its components.

The following documents shall be submitted along with the offer:

- 10.1.9 Technical data sheets & catalogues
- 10.1.10 Type test reports

The following drawings (in three sets) shall be submitted for approval/review within 3 weeks of award of contract.

- a) Street light pole GA & Mounting arrangement
- b) Technical data sheets
- c) Circuit diagrams
- d) Wiring diagrams
- e) Calculation of stability for poles
- f) O & M Manual
- g) Tests reports



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

ANNEXURE-I

SPECIFICATION FOR GALVANIZED IRON OCTAGONAL POLES

1.0 DESIGN

The Octagonal Poles shall be designed to withstand the maximum wind speed as per IS 875. The top loading i.e area and the weight of Fixtures are to be calculate maximum deflection of the poles and the same shall meet the requirement of BS: 5649 Part VI 1982.

Length of poles shall generally be 9m /6m/3m as specified in technical specification. If not specified in TS then length to be considered as 9m.

2.0 POLE SHAFT

The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by Submerged Arc welding (SAW) process.

3.0 DOOR OPENING

The octagonal poles shall have door of approximate 500 mm length at the elevation of 500 mm from the Base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall be suitable arrangement for the purpose of earthing.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

4.0 MATERIAL

Octagonal Poles	HT Steel Conforming to grade S355JO
Base Plate	Fe 410 conforming to IS 226/IS 2062
Foundation Bolts	EN.8 grade.

5.0 WELDING

The welding shall be carried out conforming to approved procedures and duly qualified by third party inspection agency. The welders shall also be qualified for welding the octagonal shafts.

6.0 POLE SECTION


The octagonal poles shall be in single section (upto 11 mtr). There shall not be any circumferential weld joint.

7.0 GALVANIZATION

The poles shall be hot dip galvanized as per IS 2629/ IS 2633 / IS 4759 standards with average coating thickness of 70 micron. The galvanizing shall be done in single dipping.

8.0 FIXING TYPE

The octagonal poles shall be bolted on a pre cast foundation with a set of four foundation bolts for greater rigidity.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

9.0 TOP MOUNTINGS

The galvanized mounting bracket shall be supplied along with the octagonal poles for installation of the luminaries.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SPECIFICATION FOR

UN-INTERRUPTED POWER SUPPLY (UPS) SYSTEM

SPECIFICATION NO.-



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

C O N T E N T S

SL. NO.	DESCRIPTION
1.0	INTENT
2.0	CODES & STANDARDS
3.0	TECHNICAL REQUIREMENTS
4.0	DRAWINGS
5.0	TESTS & ACCEPTANCE
6.0	PACKING & TRANSPORT
7.0	TYPICAL CALCULATIONS



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 INTENT

- a) The intent of this specification is to define the general requirements for design, manufacture, assembly and testing at manufacturer's works, packing, transportation and receipt at site with all materials and accessories of uninterrupted power supply system with static bypass, solid state voltage stabilizer for by-pass supply, Rectifiers, Inverter system, distribution boards and the associated battery sets.
- b) Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:
1. Requirement of UPS (3 Phase/ Single Phase) for specific application and its rating & voltage level.
 2. Requirement for Parallel redundant / Standalone UPS
 3. Type of battery and its AH/kWH capacity
 4. Requirement for SCR/ Thyristor based / IGBT Based rectifier bridge and corresponding THD allowable limit.
 5. Incoming power feeder details
 6. Location of UPS and its cooling requirements

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 CODES & STANDARDS

The UPS System & its accessories shall comply with the latest edition of the following and other relevant Indian standards. In case equipment is supplied by foreign manufacturers relevant international standards shall be applicable.


- IS:16242-2014 - Specification for Uninterruptible power systems
- IS:3700- 1970 - Essential ratings and characteristics of semi-conductor devices
- IS:5469- 1973 - Code of practice for the use of semi-conductor junction devices
- IS:12970 - 2010 - Specification for Semiconductor Devices – Integrated circuits
- Specification for stationary cells and batteries Lead acid type with Plante positive plates.
- IEC-623 - Specification for Nickel cadmium rechargeable batteries
- Specification for Low Voltage Switchgear And Controlgear
- IEC-60240-1:2008 - Specification for Uninterruptible power systems

IEEE - Recommended practice for electrical power distribution (Std. 141) for industrial plants

3.0 TECHNICAL FEATURES

3.1 UPS SYSTEM

The UPS shall consist of Rectifier / Charger, Battery, Inverter, Static Transfer Switch, Maintenance Bypass Switch, Synchronizing Equipment, Protective Device and other Accessories. The UPS shall provide continuous electric power within specified tolerance, without interruption, to the critical loads. Normally electric energy from normal plant power source shall be supplied to UPS System. The solid-state rectifier / charger shall convert incoming AC power to DC power. The rectifier / charger output

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

shall be fed to solid-state inverter. The inverter shall convert the DC power into AC power, which shall supply the load.

Upon failure of AC power, input power for inverter shall automatically be supplied from the battery with no interruption / disturbance in inverter output in excess of limits specified herein (in these specifications). At the same time, UPS shall energize an alarm circuit. The duration for which Battery shall supply A/C power to O/P shall be minimum 30 minutes.

When A/C power is restored, the input power for the inverter and for recharging the battery shall automatically be supplied from rectifier / charger output without interruption/ disturbance in inverter output in excess of limits specified herein (in these specifications). The solid-state circuitry used for both Rectifier & Inverter shall be IGBT technology. Rectifier may be SCR/Thyristor based if specified in TS.

Intelligent RS-232 Communication shall be possible which will Provide UPS status indications, electrical parameters such as Input & Output Voltage, Load levels etc and unattended shutdown. User-friendly LCD Display to indicate all important UPS parameters such as Input Voltage, Output Voltage, Battery Level and Load Level shall be provided.

3.2 Design criteria for Uninterrupted Power Supply (UPS)

UPS shall meet the following requirements:

1. a) Parallel redundant UPS system shall be provided if not specified in TS . Each UPS shall be rated for full capacity and under normal condition both shall be sharing the load. In case of failure of any UPS, the remaining UPS shall take the full load.
b) Standalone UPS (without redundancy) may be considered based on application requirements if specified in TS.
2. Spare capacity of UPS shall be 50%.
3. Load factor or diversity factor shall not be considered while calculating the load on UPS.
4. Two separate power supply from different sources shall be provided to UPS – one for UPS and the other for Bypass.
5. Three phase input supply with single phase output shall be considered for UPS rating of 10 KVA and above.
6. Three phase input supply (Or Single phase input supply if specified in TS) with single phase output shall be considered for UPS rating from 5KVA up to below 10 KVA / as per standard manufacturing practices of OEM.
7. Single phase input supply with single phase output shall be considered for UPS rating of below 5 KVA.
8. Single Bypass supply to equipment shall be through constant voltage transformer. UPS system shall have bump less transfer from UPS to by pass and vice versa.
9. UPS panel shall preferably be located in ventilated room / control room.
10. Separate battery room with proper exhaust ventilation shall be considered for battery bank.




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Other design particulars shall be as follows:

1.0	Basic Design parameters:		
(i)	Input Voltage	:	415 V AC / 240VAC +/- 10, -15% , 3-Phase ,4 wire, grounded neutral system with a symmetrical fault level of 50 KA RMS
(ii)	Input Frequency	:	50 Hz. +/- 5%
(iii)	Output Voltage	:	240 V AC , 1-Phase
(iv)	Output Voltage tolerance	:	+/- 1%
(v)	Output Frequency	:	50 Hz. +/- 0.1%
(vi)	Output Voltage wave form	:	Sine wave
(vii)	Harmonic Distortion	:	Less than 3% for individual harmonics Less than 5% for total harmonics distortion
(viii)	Voltage Distortion	:	Less than 3% for 100% linear loads Less than 5% for nonlinear loads
(ix)	Phase Displacement	:	120 deg. +/- 1deg. for balanced load 120 deg. +/- 3deg. for unbalanced load
(x)	Transient recovery	:	Shall return to steady state condition in less than 100 msec . after a disturbance
(xi)	Maximum ambient	:	50 deg.C
2.0	Basic details:		
(i)	Duty type	:	Online continuous
(ii)	Reference standard	:	Features and performance in line with IEEE 446
(iii)	Overload	:	125% of the rated output for 15 minutes 150% of the rated output for 30 sec
(iv)	Configuration	:	With isolating transformer, rectifier, inverter unit and necessary DC batteries
(v)	Power device	:	Inverter power circuit shall comprise of IGBT using PWM control technique
(vi)	Redundancy	:	The system shall be of parallel redundant type with bumpless transfers.
(vii)	Static bypass	:	Automatic static bypass and common DC battery bank . The load shall normally be fed from the inverter. In addition to static bypass switch , a manual changeover switch (MCCB) of adequate rating shall be provided to supply the load directly (bypassing the rectifier/charger,

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

inverter, and static transfer switch) from the mains instead of through the UPS system .

(viii) Battery bank : Sealed maintenance free NiCd batteries OR VRLA batteries (As per TS) shall be provided for the battery bank .

The batteries shall be housed in a separate battery cabinet/battery Stand.

A battery disconnect circuit breaker with undervoltage release (UVR) shall be included for isolation of the battery pack from the UPS module.

The UPS shall automatically be disconnected from the battery by opening the breaker when the battery reaches the minimum discharge voltage level.

Casters and leveling feet shall also be provided with the battery power pack cabinet for ease of installation.

(ix) Battery backup : Battery shall be suitable to maintain the power supply for at least 30 minutes (or as specified in TS) in the event of mains failure with rated capacity of the UPS at full load

(x) Battery management system : UPS shall have latest 'Battery Management System' to charge / discharge the entire battery automatically

(xi) AC DB : Necessary distribution board for distribution of power from UPS output to individual consumers

(xii) Loading capability : UPS shall be capable of taking 100 % non linear loads

(xiii) Interchangeability of sub assemblies : The UPS shall be constructed of replaceable subassemblies PCB's shall be plug-in type Like assemblies and like components shall be interchangeable

(xiv) Noise level : Maximum noise level shall be less than 60 dB at a distance of 1 m from the body of the UPS

(xv) Efficiency : The efficiency values of UPS under 50% unbalanced load & 100 % linear loads shall be as near as possible to normal efficiency


(xvi) Isolation transformer : The isolation transformer shall be of dry type and shall be provided on both input and output side of the UPS

(xvii) Grounding : The AC output neutral shall be electrically isolated from the UPS chassis. The UPS chassis shall have an equipment ground terminal

. Provisions for local bonding shall be provided.

Component mounted doors shall be separately earthed through 2.5 sq.mm PVC insulated green/green-yellow color flexible copper wire .

(xviii) Communication port : The UPS shall have inbuilt RS 485 port for display of online status of UPS on HMI


	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- 3.0 **Rectifier** :
- of online status of UPS on HMI .
 - Dual rectifier with each unit rated for supplying both inverter load and battery charger load in different modes.
 - Rectifier unit shall consist of minimum six pulse IGBT (Or as specified in TS) bridge connection .
 - With necessary smoothing reactor and filters
 - Automatic boost and float charging control.
 - Equalizing mode for compensating the charge lost by the battery after a discharge automatic changeover from equalizing mode to float mode
- 4.0 **Protective features** :
- and vice-versa .
 - Maximum current limiting .
 - Automatic reduction of current limit in the event of cooling fan failure .
- 5.0 **Inverter** :
- Boost charging and float charging current limiting
 - With input circuit consisting of battery contactor, battery filter and smoothing reactor .
 - DC/AC converter for voltage control .
 - Inverter proper and control electronics .
 - Series reactor and parallel filter .
- 6.0 **Protection** :
- Abnormal output voltage (over voltage & under voltage) .
 - Abnormal link voltage . understanding
 - Over current on output .
 - Over current on input or commutating failure .
 - Low battery voltage .
 - High transformer temperature .
 - Auxiliary supply failure .
 - Fan failure
 - Logic failure
 - Clock failure
 - Fast acting HRC fuse for inverter circuit and control circuit

- 7.0 **Static by-pass switch** :
- Static switch automatically switches the load to the reserve power supply for the mains whenever there is failure in inverter supply to the load.
 - Fast acting inverter contactor shall connect the inverter output to the load.
 - High speed fuses shall be provided for protecting the thyristor against accidental overload.

8.0 Indicating meters to be provided on the ACDB panel

- : • Input voltmeter with selector switches.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- Input ammeter with selector switches
- DC voltmeter with selector switches
- Centre zero type DC ammeter for measurement of charging/discharging current from the battery .
- AC output voltmeter with selector switch
- Separate frequency meter to see Input and Output frequency .
- AC output ammeter with selector switch
- AC voltmeter with selector switch for bypass circuit .
- AC ammeter with selector switch for bypass circuit .
- Frequency meter for bypass circuit .

9.0 MIMIC on UPS panels :

- MIMIC of the system power flow diagram as single-line diagram of the UPS shall be provided on UPS panels front door with long-life LED's integrated within the single line diagram to indicate the operating status of different components/sections of the UPS.

10.0 Display and Operating system

- The UPS shall be provided with a microprocessor based keypad and display unit mounted on UPS panels front door for operating and viewing the UPS status for convenient and reliable user operation .
- The monitoring functions such as metering, status and alarms shall be displayed on an alphanumeric LCD display.
Additional features of the monitoring system shall include:
- Menu-driven display with text format
- Real time clock (time and date)
- Alarm history with time and date stamp (minimum upto 16 faults in memory with FIFO sequence)
- Battery back-up memory

11 Metering :

The following parameters shall be displayed:

- Input AC voltage line-to-line and line-to-neutral for each phase.
- Input AC current for each phase
- Input frequency
- Battery voltage status
- Battery charge/discharge current
- Output AC voltage
- Output AC current
- Output frequency
- Percent of rated load being supplied by the UPS
 - Battery time left during battery operation .

12 Alarm Messages :

- Input power out of tolerance
 - Input phase rotation incorrect
 - Incorrect input frequency
 - Charger in reduced current mode
 - Battery charger problem
 - Battery failed test
 - Low battery voltage warning or blown battery fuse
 - High battery voltage
 - DC bus overvoltage
 - Bypass frequency out of range

- Load transferred to bypass
- Excessive retransfers attempted
- Static switch failure
- UPS output not synchronized to input power
- Input power single phased
- Input voltage sensor failed
- Inverter leg overcurrent in X-phase
- Output undervoltage
- Output overvoltage
- Output overcurrent
- System output overloaded
- Load transferred to bypass due to overload
- Fan failure
- Overtemperature shutdown
- An audible alarm shall be provided and activated by any of the above alarm conditions.

13 Status Messages :

- Normal operation
Load on maintenance bypass
- Load on UPS
- Load on static bypass
- System shutdown
- UPS on battery

14 Controls :

- UPS start-up / shutdown shall be done by push button / rotary control switch
- Normal operation / bypass operations shall be done by a single rotary control switch.
- An advisory display and menu-driven user prompts writeup sticker (pasted inside the panel door) shall be provided to guide the operator through system operation without the use of additional manuals.
- Pushbuttons shall be provided to display the status of the UPS and to test and reset visual and audible alarms.

The UPS system shall consist of a dedicated ACDB panel consisting of Incoming and Outgoing terminal blocks, MCCB's, power and auxiliary contactors, isolation transformers.

(i) Isolation devices :

- MCCB in incoming side
- SPN MCB (of adequate rating) in outgoing side.
- Power circuit isolation device to have pad locking in the OFF position with the door closed

(ii) Installation :

- Metal clad , indoor installation

(iii) Mounting :

- Floor mounting with base channel of ISMC-75

(iv) Enclosure protection :

- Totally enclosed dust and vermin proof.

(v) UPS housing :

- IP – 31 or better (with exhaust arrangement)



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- Each UPS system shall be housed in a separate cubicle, complete with an individual front and back access door with concealed type hinges.
- For UPS panel all the switches, indication lamps and meters shall be flush mounted on the respective compartment door.
- For ACDB panel the input MCCB's and output MCB's shall be operated from outside the panel door.

(vi) Back access :

- Each panel shall have a door on back side . All the doors shall have neoprene/polyurethane gasket .
- Natural rubber gasket shall be provided between adjacent panel doors and removal covers.

(vii) Lifting hooks :

- Lifting hooks for each panel shall be provided

(viii) Designation plate for UPS

: Inscription plate for each panel :-

- Name plate shall be provided at top centre of the UPS panel.

- Name plates will be of Anodised Aluminium with white letters engraved on black background and in English language.
 - Letter height for UPS designation plate shall be in the range of 25-50 mm .
- Individual components shall be identified with identification plate and shall match with the identification tags mentioned in the drawing.
- Danger board shall be provided on front and rear side of the UPS both in Hindi, English & regional languages.

(ix) Thickness of sheet steel (CRCA)

- : • Load bearing members : 2.0 mm
• Non load bearing member : 1.6 mm

(x) Door earthing :

- Hinged door at front and back with flexible earthing connection.

(xi) Cable entry :

- Incomer :- Bottom cable entry
- Outgoing :- Bottom cable entry

(xii) Gland plates


- : • Undrilled removable bottom gland plates (3 mm thick)

(xiii) Output power indication

- Auxiliary contactors shall be provided in output side of the UPS for potential free contacts for indication of UPS and non UPS power supply at different location.
- Proper transducers shall be provided for voltage and frequency indication at different locations .

(xiv) Cooling of panels :

- Panels shall have fan installed vertically at top for forced air draft and louvers with screen protection in bottom.
- Fans shall be powered from UPS output. Low velocity fans shall be used to minimize audible noise output.
- The thermal design, along with all thermal and ambient sensors, shall be coordinated with the

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

protective devices before excessive component or internal cabinet temperatures are exceeded.

- The UPS shall be installed in air conditioned environment.

(xv) Bolts , nuts & cable glands

- All bolts and nuts for terminations shall be cadmium coated.
- Double compression cable glands for receiving external power & control cables.
- Compartment door interlocked with the isolating device for safety with provision for defeating it by authorized person

(xvi) Indicating lamps :

- All indicating lamps shall be of LED high density type.

(xvii) Finish :

- Interior and exterior :- RAL 7035

(xviii) Terminal block :

- Terminal block for incoming cable shall be located in back side and outgoing cables shall be in front side of the ACDB panel.
- All incoming terminal blocks shall be fully insulated for the working voltage.
- The terminal blocks shall be sleeved color coded Red , Yellow , Blue , Black for R,Y,B,N respectively using heat shrinkable PVC sleeve .
- All outgoing terminal blocks shall be sleeved color coded Red and Black for line and phase respectively using heat shrinkable PVC sleeve.
- All the terminal blocks shall be shrouded.
- Not more than two connections shall be made at one terminal.
- Terminal blocks shall be suitable to connect two cores of 2.5 sq.mm.
- There shall be 20 % spare terminal blocks

(xix) Minimum air clearance for bare busbars

- Phase to phase :- 25.4 mm
- Phase to earth:- 19.0 mm

(xx) Output power bus

- The solid output power bus shall be of bare copper with a minimum rating of 100 A at 240 V AC (1 pair).

(xxi) Earth bus :

- The main earth bus shall be of 50 x10 mm GI with extension at both ends of switchboard for connection to safety grounding network. Earth busbar shall run continuous throughout the UPS panel at bottom.


(xxii) Panel internal wiring:

The panel internal wiring shall be carried out by 1100 V grade , single core , black color PVC insulated , stranded copper wire of following size

- Current transformer circuit :- 4.0 sq.mm
- Control and potential circuit :-2.5 sq.mm
- Identification of wire shall be numbered by plastic/ ceramic ferrules.
- Ferrules shall be self locking type.

(xxiii) Incoming Feeders :

- 3 pole MCCB.
- Ammeter with 4-position selector switch (three phases & OFF)

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

- Voltmeter with 4-position selector switch and fuses (three line-line & OFF)
- Current transformers (for metering)
- 3 nos. indicating LED type lamps (R,Y,B)
- 3 nos. indicating LED type lamps (CB ON-Red , CB OFF- Green, CB TRIP - Amber)
- Following protections are required for the MCCB controlled
- Incomers :-
 - Overcurrent releases.
 - Short circuit.
 - Earth fault.

(xiv) Outgoing Feeders :

- Each outgoing feeder shall have followings:-
- Outgoing feeders shall have SPN MCB
- MCB of 09 kA rating with Thermo-magnetic releases.

(xv) Testing :

- All routine tests shall be as per IS-8623 (Part-II) 1993
- Type test certificate shall be submitted.

3.2 Battery and Accessories

3.2.1 Battery unit

Ampere-hour capacity of the battery shall be selected on the following basis:

- Load power factor of 0.8
- Aging factor of 0.8
- Battery state of charge factor of 0.88 or as specified by the approved manufacturer
- Temperature correction factor shall be taken as specified in data sheet
- Minimum end cell voltage shall be 1.1V per cell for Ni-Cd battery & 1.85 V per cell for SMF LA/VRLA battery as per TS.

3.2.2 The type of battery (Ni-Cd/SMF LA/VRLA) shall be as per TS :

Sets of Indoor Stationary batteries of type as per enclosed data sheet complete with all required accessories as applicable including but not limited to the following shall be supplied with each battery set;

- Battery stands in two rows/ two tier formation. Stand Material shall be as per battery manufacturer's standard.
- Cell testing voltmeter complete with leads- (1 no. Per set).
- Spanner - (1 no. Per set).

Overall dimensions of complete battery set shall be such that it can be accommodated in existing room if indicated in data sheet.

Ni-Cd Battery

The nickel cadmium cell/ battery shall be suitable for float duty operation at constant voltage permanently applied to its terminals which is sufficient to maintain it in a state close to full charge and shall be designed to supply load in the event of normal power supply failure. Battery shall be Fiber plate or Pocket plate type.

Supplier shall carry out battery sizing calculations based on load as specified and in line with various standards. The same shall be submitted to owner/consultant for approval.

Ampere-hour capacity of the battery shall be selected on the following basis:



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- a) Nominal voltage of cell shall be 1.2 V.
- b) Load power factor of 0.8
- c) Aging factor of 0.8
- d) Battery state of charge factor of 0.88
- e) Minimum ambient temperature as specified in datasheet
- f) Backup time as specified in datasheet
- g) Minimum end cell voltage shall be 1.1V per cell for Ni-Cd battery
- h) Depth of discharge as specified in datasheet

The number of cells shall be determined as per load and system voltage as specified in datasheet. Battery assembly shall be supplied in dry and uncharged condition in line with client's instructions. Electrolyte with 10% extra quantity shall be delivered with the battery in suitable, non-returnable, sealed containers.

The battery shall be charged at site and made available for working by the supplier as per client's directives.

Each cell shall have a separate container. The cell shall be housed in high strength impact resistant and alkali resistant container and should be transparent/translucent material and designed to withstand mechanical stresses, shocks and vibrations.

The components such as containers, lids/covers and seals used in the manufacture shall be fire, flame and smoke resistant.

The terminal post shall be nickel plated. The terminals shall be suitable for short circuit current and specified discharge current without damage to cell as a result of terminal heating.

Accessories to be supplied:

- i) Galvanized Steel Metallic Stand with 2 coats of black paint complete with cell number plates and fixing arrangement. Suitable for rows single tier arrangement
- ii) Alkali for first filling including 10% spare quantity.
- iii) Cell testing voltmeter 3-0-3 volts complete with leads.
- iv) Syringe type hydrometer
- v) Mercury in glass chemical thermometer 0-100 deg.
- vi) Float type level indicator
- vii) Copper cell connectors
- viii) Spanner for cells, acid resistant funnel and 2 litre jug, rubber syphon, gloves and apron.
- ix) Well type teak wood holders.
- x) Alkali proof tiles/PVC sheet to be put in floor and 1/3 of the wall in battery room.

3.2.2 Lead – Acid (Plante) battery

The battery shall comprise station class, plante type lead acid cells with tubular + ve plates in hard rubber container conforming to IS: 1652-1991. AH capacity and number of cells shall be as specified in design criteria. AH capacity shall correspond to 10-hour discharge rate to final voltage of 1.85 VPC at 27°C.

- Calculations in support of battery capacity selection shall be furnished.
- Construction of positive and negative plates shall ensure trouble free service. The cells shall have top lids to exclude dust. Vent plugs shall be provided on top lids. The battery shall be mounted on anti-acid painted teak wood stands in two rows, in double tier arrangement. The polarity of terminals shall be clearly marked.
- Accessories
All accessories required for installation, operation and maintenance of the battery shall be supplied with the battery as specified in design criteria. First filling of acid with 10% excess quantity shall be supplied in non-returnable containers.
- Accessories required for installation, operation and maintenance of battery shall be provided:

- i) Teakwood Battery stand suitable for double row, double tier arrangement for 110V system.
- ii) Cell and stand insulators.
- iii) Plastic cell number plates with fixing accessories.
- iv) Copper cell connectors with adequate lead coating.
- v) Syringe type hydrometer.
- vi) Thermometer with specific gravity correction scale.
- vii) 3-0-3V, cell testing voltmeter, class 1.0
- viii) Acid resisting funnel, rubber siphon, pair of rubber gloves, rubber apron, acid resisting jug of 2 liters, wall type teak wood holders.
- ix) Wooden Spanner and special tools (if any).
- x) First filling of acid plus 10% spare in non-returnable plastic containers.

3.7 Details to be furnished in datasheet of UPS:

- i) Name of manufacturer
- ii) Type of UPS
- iii) AC Input details – Voltage, Frequency with %age variation
- iv) kVA rating
- v) Overall dimensions
- vi) Panel enclosure details – material, thickness, IP class, paint shade etc.
- vii) Rectifier details
- viii) Static inverter details
- ix) Rated full load capacity
- x) Output voltage distortion – linear & non-linear load
- xi) Harmonic distortion
- xii) Overload capacity
- xiii) Synchronization limits
- xiv) Slew rate
- xv) Static transfer switch details
- xvi) Protections & indication details
- xvii) Battery type and rated voltage
- xviii) No. of cells
- xix) Minimum cell voltage
- xx) Maximum charging current
- xxi) Battery back up time
- xxii) Voltage stabilizer with isolation transformer details

4.0 DRAWINGS AND DOCUMENTS

4.1 The following documents shall be submitted along with the offer:


- a) List of two years operation and maintenance spare.
- b) Technical data sheet (Annex-II) and check list duly filled.

4.2 The following calculations/ dimensions shall be submitted:

- a) UPS sizing calculation.
- b) Battery sizing calculation.
- c) Battery bank/stand size.
- d) UPS panel size including solid-state stabilizer panel.

4.3 The following drawings shall be submitted for approval within 3 weeks of award of contract.

- a) G.A. of panel, battery bank with stand & ACDB
- b) Single line diagram
- c) Display & mimic details

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- d) Bill of Material
- e) Schematic & Wiring diagram for reference
- f) Battery sizing calculation
- g) Battery bank/stand size
- h) UPS Control & Protection philosophy
- i) List of LCD indication & audio alarms

4.4 Final drawings, operation & maintenance manual and erection Instructions shall be submitted along with despatch of equipments in four sets in hard copy & two sets in soft copy (CD).

5.0 INSPECTION AND TESTING

Inspection and testing of equipment shall be carried out by the owner/ consultant at the works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approved drawings and national/ international standards.

Tests shall be carried out at manufacturer's works under his care and expense.

The manufacturer shall submit a QAP inline with the format enclosed for approval of PMC. All tests and documents of inspection shall be done based on this.

The bidder shall submit the Type Test reports along with the drawing for approval for the following type tests conducted on UPS as per relevant IS and IEC within five years from the date of opening of the bid and test-witnessed by any Government Department / Government undertaking, failing which the offer is liable for rejection.

UPS testing shall be performed after wiring of the functional units to form a complete UPS either at the factory or at the installation site. The interconnecting cables shall be checked for correct wiring, insulation and quality of wiring terminations.

Type tests:

- 1) Interconnection cable check
- 2) Overload capability test
- 3) Radiofrequency interference test
- 4) On-site ventilation test
- 5) Earth Fault


Routine tests:

- 1) Full load test
- 2) Transfer test
- 3) Overload capability test
- 4) Short Circuit current capability test
- 5) Overvoltage test
- 6) Radiofrequency interference test
- 7) Noise test
- 8) On-site ventilation test
- 9) Earth Fault
- 10) Environmental tests
- 11) Vibration and shock tests

All other tests, as may be necessary to ensure that all equipment's are satisfactory shall also be carried out. In addition to the above tests, manufacturer's test certificates, vendor's test certificates for different equipment's, accessories, instruments etc. shall be submitted, whenever required by the purchaser.

6.0 PACKING AND TRANSPORT

The UPS, ACDB & other boards shall be shipped to site packed in wooden crates. They shall be wrapped with polythene sheets before being placed in crates to prevent damage to the finish. Crates shall have skid bottoms for handling.

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

7.0 TYPICAL CALCULATIONS (To be submitted by the bidder for reference/ approval):

A) UPS Sizing calculation:

Steps to calculate:

- 1 List all equipment to be protected by the UPS. (Remember to include monitors, external hard drives, routers, etc.)
2. List the amps and volts for each device. These ratings can typically be found on the label on the back of the equipment. Multiply amps by volts to determine VoltAmps (VA). Some devices may list their power requirements in watts. To convert watts to VA, divide the watts by power factor. For servers, the power factor is often 0.9.
3. Multiply the VA by the number of pieces of equipment to get the VA subtotals.
4. Add the VA subtotals together.
5. Multiply the total by 1.6 to get the total capacity. This step accounts for future expansion.Spare capacity of UPS shall be 60 %.
6. Use the grand total to select a UPS. When choosing a UPS, be sure that the total VA requirement of supported equipment does not exceed the VA rating of the UPS.

B) Battery sizing calculation:

$$\text{No. of cells} = \frac{\text{Max. DC voltage}}{\text{Boost Voltage}}$$

$$\text{No. of cells} = \frac{\text{Max. DC voltage}}{\text{End cell voltage}}$$

$$\text{DC Current} = \frac{\text{UPS (KVA)} \times 1000 \times \text{Load power factor}}{\text{Inverter efficiency} \times \text{End voltage}}$$

$$\text{Capacity of battery (AH)} = \frac{\text{DC Current} \times \text{Duration in Hrs}}{\% \text{age capacity utilization}}$$



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SPECIFICATION

FOR

HT VCB PANEL

SPECIFICATION NO.-



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

C O N T E N T S

SL. NO. DESCRIPTION

- | | |
|-----|--------------------------------|
| 1.0 | CODES AND STANDARDS |
| 1.0 | EQUIPMENT INSTALLATION |
| 3.0 | LIST OF CONSTRUCTION EQUIPMENT |



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II


Specification for Electrical Equipment Installation

1.0 CODES AND STANDARDS

The equipment shall comply with the requirements of latest revision of following standards issued by BIS (Bureau of Indian Standards), unless otherwise specified:

- IS 5 Colours for ready mixed paints and enamels
SP 30 (BIS) National Electrical Code 2011
- IS 816 Code of practice for use of metal arc welding for general construction in mild steel
- IS 1239 Steel tubes, tubulars and other wrought steel fittings
- IS 1255 Code of practice for installation and maintenance of power cables up to and including 33kV rating
- IS 1364 Hexagon head bolts, screws and nuts of product grades A and B IS 1573 Electroplated coatings of zinc on iron and steel
- IS 2309 Code of practice for the protection of buildings and allied structures against lightning
- IS 2629 Recommended practice for hot dip galvanizing of iron and steel IS 2633 Methods for testing uniformity of coating of zinc coated articles IS 3043 Code of practice for earthing
- IS 3618 Phosphate treatment of iron and steel for protection against corrosion IS 4759 Hot-dip zinc coatings on structural steel and other allied products
- IS 6005 Code of practice for phosphating of iron and steel
- IS 7689 Guide for the control of undesirable static electricity
- IS 7816 Guide for testing Insulation resistance of rotating machines
- IS 10028 :
 Part 2 Code of practice for selection, installation and maintenance of Transformers:
 Part 2 – Installation
- IS 10118 : Code of practice for selection, installation and maintenance of switchgear and
Part 3 control gear : Part 3 – Installation
- OISD-RP-110 Recommended practices on static electricity
- OISD-STD-137 Inspection of Electrical Equipment
- OISD-RP-147 Inspection and safe practices during electrical installations

In addition to the above it shall be ensured that the installation conforms to the requirements of the

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

following as applicable:

- a) Indian Electricity Act and Rules.
- b) Regulations laid down by CEA/Electrical Inspectorate.
- c) Regulations laid down by PESO/ DGMS (as applicable).
- d) The petroleum rules (ministry of Industry Government of India).
- e) Any other regulations laid down by central/state/local authorities and Insurance agencies.

In case of any contradiction between various referred standards, specifications and statutory regulations the following order of priority shall govern:

- Statutory regulations
- This specification
- Codes and standards

However the Contractor shall bring any such contradiction to the notice of Purchaser for prior approval.

2.0 EQUIPMENT INSTALLATION

Prior to start of installation of the electrical equipment contractor shall verify that equipment and complete materials have been received. Handling, shifting to required site location, installation, testing and commissioning of all electrical equipment shall be done by vendor/contractor with utmost care as per the scope matrix between the site installation contractor and respective equipment vendor attached in the each tender. Manufacturer's instructions and the requirements given in their technical manuals shall be strictly adhered. The substation/switchgear room wherein the equipment shall be installed shall be kept clean, dry and free from all debris. Panel floor cutouts not in immediate use shall be suitably covered to avoid any mishap. When handling the switchboard panels, care shall be taken to observe the correct lifting arrangements and to make sure that slings are attached to the manufacturer's designated lifting arrangements and to make sure that slings are attached to the manufacturer's designated lifting points. No parts shall be subjected to undue strains or sudden stresses which could cause damage to the equipment.

The lifting position mark indicated on packing casing shall be adhered to strictly, for keeping it in required vertical position.

Contractor shall check and report to the Purchaser about any damaged item and / or missing component for getting the same replaced as per specifications. During installation, all accessories and loose items shall also be inspected by the contractor before their assembly/mounting.

In case of any modifications/replacement of existing equipments or Tie-ins with existing Electrical systems, approvals shall be obtained from Purchaser before any work to be implemented. The tie-in and shutdown philosophy shall be developed by Contractor in coordination with production, operation and maintenance department. Detailed Task Risk Assessment (TRA) shall be developed by the Contractor for all modifications/replacement or tie-ins activities and shall be approved by all concerned authorities.


The following philosophies provide the frame work for modifications/replacement or tie-in approach:

- a) The existing facilities shall continue to operate normally. Contractor shall verify the requirements for modifications, replacement and interface or tie-in with existing / new electrical systems.

In general, a planned construction campaign shall be scheduled to facilitate the modifications/replacement or tie-in work. However, preparation for modifications/replacement or tie-in work can be proceed on an opportunistic or scheduled shutdown prior to the planned construction campaign in consultation with Purchaser. Associated shutdown co-ordination shall be carried out by the Contractor as per Purchaser procedure to complete the modifications/replacement of existing electrical equipments or tie-in hook up for all electrical systems.

Switchboards and Bus Ducts

The term switchboard here includes all HV / MV/ LV switchboard panels, motor control centres, power and lighting distribution boards, UPS panels, ACDB, charger panels, DCDB etc. The switchboard panels shall be handled with care, avoiding any impact to the equipment. Dragging of

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

the panels directly on floor shall be avoided. Roller bars may be used for shifting of panels: Use of a crane and trailer shall be made for handling of equipment. The switchboard panels shall be properly supported on the truck or trailer by means of ropes to avoid any chance of tilting. The switchboards shall be lifted after ensuring that panel supports, nuts and bolts are all intact and tightened. While lifting the panels in packed conditions utmost care shall be taken to avoid any damage to insulators, bushings, metering and protective equipment. The panels shall be preferably kept inside the packing cases till foundations are ready.

The switchboard panels shall be installed on prepared foundations or floor cutouts. Steel base channels shall be welded to inserts provided in floor slab. Cross members shall be provided at the junctions of each shipping section and other places as required. Alternatively when the floor is being-laid, base channel frame of panels supplied by the vendor shall be grouted and levelled in cement concrete. It shall be ensured that the base plate level of HV switchboard shall match with the finished floor level. The foundation pockets and the grouted bolts shall be cured for a minimum period of 48 hours.

The switchboard panels shall be taken out from the packed cases and shifted one by one to its proper place. All the panels shall be assembled, aligned and levelled: Alignment of panels shall be checked in both longitudinal and lateral directions. It shall be ensured that panel to panel coupling bolts, bus bar links etc. fit properly without any strain on any part. No new holes for jointing of the panels other than those recommended by the vendor shall be drilled. No gaps shall be left between the panels. The lifting, racking in and out operation of the breaker and all other motions shall be free from any obstruction.

The panels shall be checked for correct vertical position using pendulum weight and spirit levels. The switchboard panels shall be tack welded at suitable intervals at base channel.


After erection of switchboard panels, all uncovered portions of floor cutouts shall be covered with 6 mm thick removable chequered plates finished with floor level. The design of the chequered plates shall be such that the maximum allowable deflection is $L/200$ (where L is the span of the chequered plates in metres) for a live load of 500 kg./sq. meters. Suitable lifting arrangements shall be provided for chequered plates: The chequered plates shall be painted with a coat of red oxide zinc chromate primer after proper surface preparation as per specifications. Where specified, panels cutouts provided for future use shall be filled with lean concrete.

After completion of erection of switchboards, all the cubicles, switchboard components such as switches, starters, C.T. and P.T. chambers, busbar chamber shall be cleaned and checked for tightness of all the components. Vacuum circuit breakers shall be checked for integrity of bottle seals. All loosely

supplied items shall be fitted up. Bus bar sections or links shall be inserted and where specified, of high voltage equipment shall be insulated. Interconnection wiring between shipping sections shall be made by vendor. All the wiring connections shall also be checked. Phase sequence and polarity of PTs and CTs shall be checked. Contact resistance of all busbar joints and contactors shall be checked. Insulator shall be checked for any damage. All the starters, switches, contacts shall be cleaned with C.T.C. where required. All the moving parts shall be checked for easy and free movement. Hinges of panel doors shall be lubricated to give free and noise free movement. All openings shall be kept completely closed to avoid ingress of any foreign particles inside the panel.

Functional scheme verification of individual feeder shall be carried out and minor wiring modifications in the panel wiring, if required shall be done as per the directions of Purchaser. Special attention shall be paid to CT circuits polarity, wiring continuity and correctness in the protection as well as measurement circuits. Auto transfer scheme shall be simulated and verified. During the course of scheme verification tests, defective components if any shall be taken out, after bringing to the notice of Purchaser. The same shall be replaced by component supplied by Purchaser.

Where switchboard is damp or having a low IR value due to damaged insulators/ bushings/any other insulated parts, or any other reason, the entire switchboard shall be dried. up according to the instruction of the Purchaser for the I.R value to improve to a safe level for commissioning. Care shall be taken to protect the surrounding insulation from direct local heating during the drying up

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

process.

All the metering instruments, protective relays and other relays and contactors shall be tested as per manufacturer's recommendations and according to the instructions of the Purchaser. Protection relays shall be inserted and connected and settings adjusted as required by the Purchaser.

All moving parts, of closing/tripping mechanism, racking in and racking out mechanism, spouts and shutter closing mechanism shall be checked for proper operation. All the auxiliary contacts of breaker shall be checked-up, cleaned and contact pressure measured.

All the control wiring, PTs, bushings, bus bars, other live parts of switchgear, incoming and outgoing cables shall be meggered.

Electrical simulation tests shall be carried out for all the protective, alarm and annunciation relays and external interfaces to ascertain proper functioning.

Safety insulation mats of approved make and of required voltage grade shall be provided in the sub- Station.

Pre-Commissioning Check List:

Before commissioning any switchboard, following points shall be checked and ensured for safe energizing of the switchboard:

That the installation of equipment to be commissioned is complete in all respects with its auxiliaries and all other mounting including earthing. Openings in floor within and outside panels have been sealed off. All cover and door gaskets are intact to make the enclosure vermin proof.


- a) All the metering instruments have been checked and found in working order. Indicating lamps are healthy and are in correct position. All power and control fuses are of proper rating.
- b) That the polarity test and ratio test of all the P.T.s and C.T.s is complete and phase sequence of C.T.s conforms to the correct vector group connections. Wiring continuity and correctness are ensured in the protection and measurement circuits. Polarity of D.C. supply for all the circuits is correct.
- c) That the high voltage tests of incoming and outgoing cables have been conducted and results are satisfactory.
- d) That all the protective relays including both conventional and microprocessor based numerical relays and thermal overload relays have been tested for secondary injection tests. (Primary injection tests shall be carried out for differential protection, Restricted Earth fault protection at full / reduced current to ensure correctness of complete wiring). Relay settings, status indications, fault annunciations, data logging, display of switchboard SLDs shall be verified from MMI in case the same is provided.
- e) That I.R. Value has been recorded for bus bars, circuit breaker, incoming and outgoing cables, control wiring and potential transformers. Where required joint resistance of bus bars have been recorded and found to be satisfactory. All the surroundings and panels have been cleaned and temporary earth leads have been removed.

Bus Ducts:

The bus ducts as per issued drawings will be supplied in parts and all the parts shall be assembled and the bus bar connections shall be made at site. The insulators in bus ducts shall be inspected for any possible damage during transit and the defective ones shall be replaced. The insulators shall be cleaned. Contact surface of bus bars, bus bar bolts and nuts shall be thoroughly cleaned. Petroleum jelly shall then be applied and bolted connection made. The bus duct enclosure shall be checked for earth continuity and then earthed at two places. The bus duct shall be properly supported between switchgear and transformer. The opening in the wall where the bus duct enters the switchgear room shall be completely sealed to avoid rain water entry. Expansion joints, flexible connections etc. supplied by the manufacturer of the bus duct shall be properly connected. The bus duct levelling shall be checked with spirit level and pendulum weight.

Transformers

Transformers on receipt at site shall be unloaded by means of crane or lifting devices of adequate capacity. All lifting lugs shall be used to avoid unbalanced lifting and undue stresses on lugs. Lifting lugs if any provided for partial lifting (e.g. for active part, conservator) etc. shall not be used for

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

lifting complete transformer. Parts other than those identified for lifting of the transformer shall not be used for lifting. While slinging, care shall be taken to avoid slings touching other parts.

Before lifting transformer, it shall be ensured that all cover bolts are tightened fully. In case when it is necessary to use jacks for lifting, projections provided for the purposes of jacking shall be used. Lifting jacks shall not be used under the valves or radiator tubes. For transporting transformers from stores to site, the transformers shall be loaded on a suitable capacity truck or trailer. The transformers shall be properly supported by steel ropes and stoppers on the trailer to avoid tilting of the transformers in transit due to jerks and vibrations. At no instance the transformer shall be kept on bare ground. Where it is not possible to unload the transformer directly on a foundation, it shall be unloaded on a properly built wooden sleeper platform. A transformer shall never be left without putting stoppers to the wheels.

Transformer shall be examined, for any sign of damage in transit. Particular attention shall be given to the following in this regard:

- a) Dents on tank wall or cooling tubes.
- b) Damage to protruding parts like valves, sight glass etc.
- c) Loosening of bolts due to vibration in transit.
- d) Cracked or broken bushings.
- e) Oil leakage particularly along welds.

If anything adverse is noted the same shall be brought to the notice of Purchaser.

Contractor shall examine the transformer base, oil pit, tire walls and foundations laid by the civil contractor. It shall be ensured that oil spills cannot propagate along cable trenches. Any discrepancy noted will be brought to the notice of Purchaser. Transformers shall be placed on channels or rails over concrete foundations. The transformers shall be levelled, aligned and checked for free movement on the channels or rails. Stoppers shall be provided to the transformers immediately to prevent any movement. Normally transformers upto 1000kVA rating shall be received duly fitted with radiator tubes, conservator tanks, valves, wheels and other accessories. While the transformers of above 1000kVA rating may be supplied with loose accessories. All the accessories like radiators, cooling fans, valves, conservator tanks, explosion vent pipe, bushings and other devices which are supplied in different packages shall be checked for any transit damage and cleaned thoroughly before fixing on the transformer. All loosely supplied parts shall be assembled as per manufacturer's instruction manuals/ drawings and documents. All the connections for C.T.s bushings and other wiring shall be checked for tightness and correctness before replacing the lid or tightening all the bolts.

Topping of transformer with oil:

Before topping up with oil, transformer shall be fitted with all accessories such as valves, gauges, thermometers etc. Oil samples shall be taken from each drum and tested for determination of dielectric strength. Any sign of leakage of the barrel or of its having been opened shall be recorded and reported. It is necessary to filter the oil before the transformers are filled. It shall be ensured in oil filling operation that no air pockets are left in the tank and that no dust or moisture enters the oil. All air vents shall be opened. Oil shall be filled through a streamline oil filter using metal hose. To prevent aeration of the oil, the transformer tank shall be filled through the bottom drain valve. In a transformer with conservator tank, the rate of oil flow shall be reduced when the level is almost upto the bottom of the main cover to prevent internal pressure from rupturing the pressure relief-pipe diaphragm. Sufficient time shall be allowed for the oil to permeate the transformers and also for the locked -up air bubbles to escape. Any air accumulation in the buchholz relay shall be released.

Transformer Oil

- a) Sample of oil from the transformer shall be taken from the bottom of the tank.
- b) Testing of Oil:



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

For dielectric test, the oil shall be tested as described in IS 335. The oil shall also be tested for acidity in accordance with the methods prescribed.

Drying out of the transformers, if required, shall be carried out and record maintained in accordance with IS 10028. Normally a streamline filter shall be used for drying-up. I.R. value versus time of both windings shall be recorded during the drying-up process.

Precautions when drying

- a) The maximum sustained temperature to which transformer oil may be subjected shall be limited to 800C.
- b) The transformer shall be carefully monitored throughout the drying out process and all observations shall be carefully recorded.
- c) Drying out shall be continued so that the insulation resistance as prescribed in the standard code of practice is attained and the value remains constant for more than 12 hours. However, a minimum number of cycles shall be done for each transformer as found necessary by the Purchaser. Generally a megger reading of 2 megohms / kV at 600 C temp with a 5kV Megger may be a rough indication for stopping the dehydration.


The following work on transformers shall be performed by the vendor if specifically called for:

- a) Before finally commissioning the transformer it may sometimes be desired to run it for a few hours on short-circuit, applying a low voltage, approximately equal to the impedance voltage of the transformer. During this process, regular readings of the insulation resistance of the winding to earth and winding to winding and temperature against time shall be recorded.
- b) Testing of radiator tubes for any leakage and rectifying these by welding / brazing.

Pre-commissioning Check List:

Before commissioning of any transformer, the following points shall be checked for safe energisation of the transformer:

- a) That all the accessories have been fixed properly and transformer body and neutral are properly earthed. The transformer dehydration is over and results are satisfactory and approved by the Purchaser. In case transformers are idle for more than one month after dehydration, transformer oil has been given at least two circulations.
- b) That the oil level, in the transformer conservator tank and all the bushings is upto the marked point and the oil has been tested for dielectric strength and acidity.
- c) That the silicagel is in reactivated condition. The breather pipe is clear from any blocking and contains oil upto the proper level.
- d) The explosion vent diaphragm does not have any dents. Accumulation of any oil and air had been released.
- e) That the operation of off-load and on-load tap changers on all the tap positions is satisfactory. The mechanical parts of the on-load tap changer are lubricated. Motor IR value has taken and found satisfactory. Tap position mechanical indicator on the transformer and tap position indication meter on the control panel are reading the same tap positions. Tap changer limit switches are operating satisfactorily on the maximum and minimum tap positions. On-load tap changer contact pressure and resistance is as per manufacturers recommendations. Oil level of tap changer tank is upto the required level and oil has been tested for dielectric strength. The tap setting on which the off load tap switch is locked shall be recorded. Generally the off-load tap switch shall be kept on nominal tap.
- f) That the buchholz relay has been tested and checked up for any friction in the movement, and floats are free, all the other protective relays, alarm and annunciation relays have been tested.
- g) That all the metering equipment have been tested and polarity test of P.T's and transformer winding is satisfactory. Phase sequence and connections have been checked for proper vector group.
- h) That the ratio test and winding resistance on all the tap positions is satisfactory.

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

- i) That gaps of arcing horns for the bushings where provided are in order and earth connections for the surge diverters have been checked
- j) That the winding and oil temperature thermometer pockets contain oil and the winding and oil temperature settings on dial gauges are in order.
- k) That the transformers fitted with fans for forced air cooling have been checked up for automatic starting and stopping of the fans and air-displacement has been verified (If applicable).
- l) That the simulation tests for all external interface connection alarm, annunciation and trip circuits have been checked and are in order.
- m) That the insulation resistance of all the control circuits and IR value of the transformer windings and all the incoming and outgoing cables have been checked.
- n) That all the valves in the cooling system and valve between the Buchholz relay and the conservator tanks are in open position.
- o) That the setting of all the protective relays is at the desired value and D.C. Trip supply is healthy.

Observations after Commissioning

After switching on the transformer the following points shall be observed and recorded.


- a) The inrush magnetizing current and no-load current.
- b) Alarm, if any, or if any relay flag has operated.
- c) Voltage and current on all the three phases.
- d) Transformer hum or abnormal noise.
- e) Circulation of oil and leakages.
- f) Record current, voltage, cooling air temperature, winding temperature and oil temperature readings, hourly for 24 hours.
- g) Cable end boxes, for any over-heating.

H.V. and M.V. Motors

All the motors generally would be erected by the mechanical contractor.

Contractor shall keep the motor space heater energized as per the directions of Purchaser. Contractor shall measure the insulation resistance of motor windings. Insulation resistance of the motors shall be measured between the winding of the machine and its frame by means of a 500 / 1000V Meggarin case of 415V motors. A minimum value of 1 megohm for 415V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be improved by any of the following methods as directed by the Purchaser.

- a) Blowing hot air from external source.
- b) Putting the motor in oven:
- c) Placing heaters or lamps around and inside after making suitable guarding and covering arrangements so as to conserve the heat.
In case the insulation is low, the following method of drying has to be adopted, after consultation with Purchaser. During drying the temperature rise of winding shall not exceed the permissible value for the class of insulation used:
 - a) By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals so as to pass full load current in the stator keeping the stator winding temperature below 90° C. In this case a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. value becomes steady.
 - b) By blasting hot air from external source, Maximum temperature of winding while drying shall be 70°

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

C to 80°C (thermometer) or 90° C to 95° C by resistance method. Heating shall be done slowly first till steady temperature of winding is reached after 4 to 5 hours, and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, till steady temperature is reached. In case it is essential, the drying process can be supplemented by blower. It shall be ensured that the motor leads are correctly connected in the terminal box, as indicated in the 'Name Plate'. The covers of all terminal boxes shall be properly fixed, the gaskets intact. The control circuit shall be tested for proper functioning as per circuit diagram.

In case of synchronous machines, slip rings and brush gear shall be polished and brushes shall be fixed in their holders with clearance and pressure as recommended by the manufacturers.

Before commissioning, the ventilation and cooling system of the motor must be inspected. In case of motor with forced ventilation the air inlet shall be examined to ensure that it is free from moisture and any foreign material. It shall also be ensured that recommended flow and pressure of air is available to produce the required cooling effect.

The motor control gear shall also be carefully examined, the over-load settings may be reduced or time lags bypassed from protective gear to ensure rapid tripping of switchgear in event of faults. The direction of rotation of a new motor specially of large capacity, and phase sequence of supply shall be kept in view while joining and connecting to the motor terminals.

Finally the motor shall be started on no-load after decoupling, and shall be allowed to run for a minimum period of 4 hours, or for a time as instructed by Purchaser. Attention shall be given to the proper running of the bearings, vibration or unusual noises if any. Voltage, starting current, no load current, stator winding and bearing temperature shall be recorded after every 1 hour during this test. Direction of rotation shall be checked and recorded. Normally the motors run in clockwise direction as viewed from the driving end with reference to the phase sequence R, Y, B.

After switching off the motor, the insulation resistance of the motor shall be recorded under hot and cold conditions.

If the no load test run is found satisfactory, the motor shall be allowed to run for 8 hours and all readings shall be recorded.

The following work on motors, may be performed by the contractor if specifically called for.


- a) The proper level of bearing oil has to be checked. The condition of grease in bearings shall be checked and in case it is necessary, complete replacement of bearing with specified grade of grease after proper cleaning of the bearing shall have to be done. Wherever external greasing facility exists, the condition of grease may be checked by pumping some new grease of specified grade at start. If the grease coming out is deteriorated grease shall be replaced.
- b) All the motors, motor exciter set and induction generators directly coupled or coupled through reduction gears shall be checked for abnormal vibration, if any Large rated HV motors with journal type bearings are liable to get damaged from shock, rough handling during transit. Any minor defect in a race or roller may give rise to considerable amount of vibration and noise. Contractor shall check and bring to the attention of Purchaser any defect noticed in this regard.
- c) Due care shall be taken to avoid any damage to bearing insulation wherever provided. Batteries Battery (Lead acid, Nickel Cadmium or VRLA type as specified) shall be erected on stands and insulators supplied by the manufacturer of the batteries. The installation shall be done as per the layout drawings and manufacturer's instructions. Electrolyte if required / as applicable shall be filled as per manufacturer's instructions. Inter row connections shall be made with the leads supplied by the manufacturer.

Neutral Earthing Resistor

The neutral earthing resistor shall be inspected for any damage to the resistor grid and other components. The resistor shall be levelled and installed. All covers etc. shall be checked for tightness to ensure that the enclosure of the resistor is dust, vermin and weatherproof. Earthing conductors shall be taken from the out end terminal of the resistor, for connection to earth electrodes and to the main grid.

Welding Receptacles

The welding receptacles shall be erected on steel/concrete structures as per the drawings. In isolated places a separate support shall be fabricated and installed.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Push Button/Control Stations

The push buttons / control stations shall be installed near to the motors to be controlled. Individual channel supports shall be installed as per standard. If control stations for hazardous areas are to be supplied by contractor, these shall be of Ex (d) type, tested by CMRI and approved by CCE or other applicable certifying authorities. All outdoor push buttons / control stations shall preferably have integral canopies for additional weather protection. The canopy shall be made of 2 mm thick galvanized sheet steel or FRP where these are not integral with the equipment.

Gang operated Isolators/outdoor Disconnectors

The isolators shall be transported to site in the dismantled condition. All the insulators may be also supplied loose. The contractor shall inspect, clean, assemble and install the isolator on the base structure previously fabricated, erected and levelled by him. The operating mechanism shall be installed on the structure and connected to the isolator poles. The operating mechanism shall be tested by slowly bringing the isolator to the closed position and carrying out the necessary adjustment as per the manufacturer's instructions. The earthing switches, frames and operating handle etc. shall be earthed.

Miscellaneous Items

Contractor shall provide the following items in substation, as per Indian Electricity Rules

Fire buckets filled with clean dry sand and ready for immediate use for extinguishing fires and fire extinguisher (carbon dioxide, dry chemical extinguisher etc.) suitable for dealing with electric fires shall be conspicuously marked and kept.

First aid boxes containing ointments and medicines for immediate treatment of injuries (As prescribed by Indian Red Cross Society or equivalent).

Instructions of restoration of persons suffering from electric shock in English, Hindi and local language of the district shall be affixed in a conspicuous place.

Danger boards (H.V., M.V.) shall be provided on transformer gate, switchboards, entrance to switchgear room and at other places as required by Purchaser.

Generators

Contractor shall install main, emergency or standby generators with their gas turbine or diesel engine drivers, and equipment associated with these 'packages', in locations as shown on the AFC contract drawings and in accordance with manufacturer's instructions. Contractor shall install and terminate interconnecting cables in accordance with equipment vendor's drawings and contract drawings.


Contractor shall check the installation and correctness of the various protection devices fitted to medium voltage machines. Anti-condensation heaters where fitted shall be connected up to a temporary supply and left energized as soon as equipment is delivered.

CABLE INSTALLATION

General

Cable installation shall include power, control and lighting cables. These shall be laid in trenches/cable trays as detailed in the power layout drawings. Cable routing given on the power layout drawings shall be checked in the field so as to avoid interference with other services such as piping, instrumentation, civil, structural, mechanical etc. Any change in routing shall be done to suit the field conditions suitably interfacing with other services wherever deemed necessary, after obtaining approval of Purchaser.

High voltage, medium voltage power and control cables shall be separated from each other by

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

adequate spacing or by running through independent pipes, trenches or cables trays, as shown on power layout drawings/installation details. Details of cable routes and cable spacings not shown in detail drawing shall be determined by the Contractor and approved by the Purchaser.

High voltage, medium voltage power and control cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cable trays, as shown on layout drawings/installation standards. Details of cable routes and cable spacings not shown in detail on these drawing shall be determined by the Contractor and approved by the Purchaser.

When single core cables are laid in flat formation, the individual cable fixing clamps and spacers shall be of non-magnetic material. As a general practice, the sheath of single core cables shall be earthed at one point to keep sheath at earth potential unless otherwise stated. Single core cables, when laid in trefoil formation shall be braced by suitable clamps at a distance, not exceeding 3 meters along the cable routing.

If straight through joints are required to be provided on single core cables, armour shall be broken at joints as per Supplier's recommendations. For single core cables, armour shall be earthed at one end for the cable run length as per Supplier's recommendation.

Minimum spacing of 300 mm between power, control cables and Telephone, Communication, Fire alarm cables shall be maintained.

The lengths indicated in the cables schedule are only approximate. The Contractor shall ascertain the exact length of cable for a particular feeder by measuring at site. All cable routes shall be carefully measured. Before the start of cable laying, the Contractor shall prepare cable drum schedule and get that approved by Purchaser to minimize/avoid.

straight through joints and then the cables cut to the required lengths, leaving sufficient lengths for the terminations of the cable at both ends. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. Extra loop length shall be given for feeder cables where required as per the directions of Purchaser to meet contingencies.

Cables shall be laid in directly buried trench or in RCC trench (underground trench) or in cable tray along pipe sleepers or in over head trays as shown on power layout drawings.

Overhead trays shall be installed 2700 mm (minimum) above grade level. At road crossings overhead trays shall be installed at 7000 mm (minimum) above level or cables shall be routed cable tray culvert/Electrical road crossings as per power layout drawings.

Sufficient care shall be taken while laying cables to avoid formation of twist, sharp bend etc. in order to avoid mechanical injuries to cables. Rollers shall be used for pulling of cables.


Cable installation shall provide minimum cable bending radii as recommended by cable Supplier. Cables shall be neatly arranged in the trenches/trays in such a manner that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be in line with power layout drawings. Cable routing between cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45 to the trench wall. Bending radii of pipes shall not be less than 8D. It is to be ensured that both the ends of GI pipe sleeves shall be sealed with approved weather proof sealing plastic compound after cabling. In places where it is not possible, cables shall be laid in smaller branch trenches.

All cables shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tag numbers shall be punched on aluminium straps (2mm thick, 20 mm wide and of enough length) securely fastened to the cable and wrapped around it.

Each underground cable shall be provided with cable tags of lead securely fastened every 30 m of its underground length with at least one tag at each end before the cable enters/leaves the ground. In unpaved areas, cable trenches shall be identified by means of cable markers as per installation drawing. These cable markers shall be placed at location of changes in the direction of cables and at intervals of not more than 20 m and also at cable straight through joint locations.

All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of cables shall be taped with an approved PVC end cap or rubber insulating tape.

Each row of cables shall be laid in place and before covering with sand. All wall opening/pipe

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building /lined trench. Every cable shall be given an insulation test in presence of Purchaser before filling the cable trench with sand. Any cable which is found defective shall be replaced.

Where cables pass through foundation walls, the necessary openings shall be provided in advance for the same by another agency. However, should it become necessary to cut holes in existing structures for example floor slab etc., the Contractor shall determine their location and obtain approval of the Purchaser before carrying out the same.

Cables for road crossings shall be taken through ERC (Electrical Road Crossing) as shown in the power layout drawings.

At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.

Wherever cable trench crosses storm water, waste water channel/drain, cables shall be taken through PVC/RCC pipes. Where cables are required to cross drains of depth more than 1200 mm, cables shall be taken over the drain on cable trays supported suitably using ISMC 150/200 sections. Ends of cables leaving trench shall be coiled & capped and provided with protective cover till such time the final termination to the equipment is completed.

Cables laid direct in ground

Cables shall be laid underground in excavated cable trenches where specified in cable layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables. Cables shall be properly spaced and arranged with a view of heat dissipation and economy of design. Maximum number of cable layers in trench shall be preferably limited to 5 layers.

Minimum depth of cable trench shall be 750 mm for medium voltage and 900 mm for H.V. Cables. The depth and the width of the trench shall vary depending upon the number of layers of cables

Cables shall be laid in buried trenches at depth as shown in the power layout drawings. It is to be insured by the Contractor that the bottom of buried trenches shall be cleared of all rocks, stones and sharp objects before cables are placed. The trench bottom shall be filled with a layer of sand. This sand shall be levelled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the largest diameter cable and sand shall be lightly compacted. A flat protective covering of 75mm thick second class red bricks shall then be laid and the remainder of the trench shall then be back – filled with soil, rammed and levelled.

Cables laid in concrete trench

Cables shall be laid in 3 or 4 tiers in concrete trench as shown on power layout drawings. Concrete cables trenches shall be filled with sand in hazardous area to avoid accumulation of hazardous gases and oil. RCC covers of trenches shall be effectively sealed to avoid ingress of chemical and oil in process area. Removal of concrete covers where required for the purpose of cable laying and reinstating them in their proper position after cables are laid shall be done by Contractor.

All wall opening /pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water.

Above ground cables

- a) Cables installed above grade shall be run in cable trays, clamped on walls, ceiling or structures and shall be run parallel or at right angles to beams, walls or columns. Cable routing shall be planned to be away from heat sources such as hot piping, gas, water, oil drainage piping, air-conditioning duct etc. Each cable tray shall contain only one layer of cables as far as possible for power cables. However control cables may be laid in double layer in the cable trays.
- b) Individual cable or small group of cables (upto 3 to 4 cables) which run along structures/walls etc. shall be clamped by means of 16 SWG GI saddles on 25 x 6 mm saddle bars. Alternatively small group of cables can be taken through 100/150 mm slotted channel tray/ISMC 100.

Cables shall be supported so as to prevent sagging. In general, distance between supports shall be approximately 300 mm for cables upto 25 diameters and maximum 450 mm for cables larger than 25 mm dia. To prevent the sagging of cables.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- c) Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. saddles/clams, whereas cables in horizontal run of cable trays shall be tied by means of nylon cords. Distance between supporting angles shall not exceed 600 mm.
- d) All cable trays (other than galvanized trays) and supporting steel structures shall be painted before laying of cables. The under surfaces shall be properly degreased, derusted, descaled and cleaned. The painting shall be done with one coat of redoxide zinc chromate primer. Final painting shall be done with two coats of approved bituminous aluminum paint unless otherwise specified.
- e) Where cables rise from trench to motor, lighting panel, control station, junction box etc., they shall be taken in GI pipe for mechanical protection upto a minimum of 300 mm above grade. Cable ends shall be carefully pulled through conduit to prevent damage to cable.
- f) All G.I. Pipes shall be laid as per layout drawings and site conditions. Before fabrication of various profiles of pipes by hydraulically operated bending machine (which is to be arranged by the Contractor) all the burrs from the pipes shall be removed. GI Pipes having bends shall be buried in soil/concrete in such a way that the bend shall be totally concealed. For G.I. pipes buried in soil, bitumen coating shall be applied on the buried lengths. Installation of G.I. pipes shall be undertaken

well before paving is completed and necessary co ordination with paving agency shall be the responsibility of Contractor.

Following guide shall be used for sizing of G.I. pipe.

- i) 1 cable in a pipe - 53 % of pipe cross-sectional area occupied by cables.
- ii) 2 cables in a pipe - 31 % of pipe cross-sectional area occupied by cables.
- iii) 3 cables in a pipe - 43 % of pipe cross-sectional area occupied by cables.
- iv) 4 and above cables in a pipe - 40 % of pipe cross-sectional area occupied by cables.

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound / bitumen / suitable sealing compound. Alternatively rubber bushes shall be employed for the purpose of sealing

Terminations

- a) All HV and MV cables shall be terminated at the equipment by means of single/double compression type cables glands as specified suitable for the cable size. They shall have a screwed nipple with conduit electrical threads and check nut. The cables shall be identified close to their termination points at both the ends of cable (cable numbers shall be punched on aluminium strips 2mm thick and securely fastened to the cables wrapped around it) and also along the route at recommended intervals, by cable tag numbers.

All cable entries for outdoor termination shall be preferably through bottom. Outdoor cable termination through top of equipment shall not be permitted.

- b) Power cables cores wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminum connections are made, necessary bimetallic washers shall be used.
- c) In case of control cables, all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules suitable for core size. Wire numbers shall be as per schematic/wiring/inter-connection diagram. All unused spare cores of control, cables shall be neatly bunched and ferruled with cable tag at both ends, for future use.
For trip circuit identification additional red ferules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.
- d) Contractor shall drill holes for fixing glands wherever necessary. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables. All unused cable entries on equipment/panels shall be plugged/sealed.
- e) The cable shall be terminated at electrical equipment /switchboards through glands of proper size.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

The individual cores shall then be dressed and taken along the cables ways or shall be fixed to the panels with polyethylene straps. The cable glanding shall be done as per Supplier's instructions. Cable armour shall not be exposed after termination is complete. In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit holes shall be drilled in the gland plate for all the cables in one line, and then gland plate shall be split in two parts along

the centre line of holes. After fixing bottom plate, uncovered cable holes/gaps shall be sealed with cold setting compound.


- f) Crimping of lugs to cable leads shall be done by hand crimping/hydraulically operated tool as per requirement. Insulation of the leads shall be removed before crimping. Conductor surface shall be cleaned and shall not be left open. Suitable conducting jelly shall be applied on the conductor lead. Lugs shall enclose all strands of cable core. Cutting of stands shall not be allowed.
- g) HV cables shall be terminated with heat shrinkable termination kits, indoor or outdoor type as specified by approved HV cable jointers. Supplier's instructions shall be followed for applying heat shrinkable termination kits.
- h) The Contractor shall bring to the notice of Purchaser any mismatch in cable glands, lugs provided with the equipment vis-à-vis to the cable size indicated in cable schedule for taking corrective action.
- i) The cable joints in power and control cables shall be avoided as far as possible. In case a joint is unavoidable, the following shall be insured:
 - i) The number of joints shall be restricted to minimum as far as possible.
 - ii) The location of joints shall be identified with permanent markers.
- iii) No joints shall be allowed in hazardous areas without the approval of Purchaser.
- iv) No joints will be allowed in the Cable seller.
 - jointing and termination of medium voltage power cables shall be carried out by trained personnel only. Jointing and termination of high voltage cables shall be done by skilled and experienced jointer duly approved by Purchaser. Only type tested termination kits of approved make shall be used.
- j) No unauthorized repairs, modifications shall be carried out on the hazardous area equipment terminal boxes and junction boxes. Damaged enclosures of hazardous area equipment shall be brought to the notice of Purchaser by Contractor. After termination is complete, all the bolts, nuts, hard wares of terminal box shall be properly placed in its position and tightened.
- k) Where required, cable sealing boxes intended to be used with the apparatus shall be filled with solid setting type bituminous compound unless otherwise specified.

LIGHTING INSTALLATION

General

The lighting fixtures in the plant shall be fed from lighting and small power distribution board. All outdoor lighting shall be group controlled manually or through photoelectric synchronous timer. Lighting wiring between distribution boards and lighting fixtures shall be done with 3-core (phase, neutral and earth) Cu/XLPE/SWA/PVC cable for plant areas and substation building. Wiring in the other building shall be done by means of 3-core Cu/PVC cables, or PVC insulated copper conductor wires in conduit/Metsec channel as specified. All joints of conductors in Switch boards/JBs Fittings shall be made only by means of approved mechanical connectors (nylon/PVC connectors). Bare twisted joints shall not be permitted anywhere in the wiring system.

The lighting and small power layouts furnished by Purchaser will indicate approximate locations of lighting fixtures. The Contractor shall determine, with approval of Purchaser, the exact locations of each fixture in order to avoid interference with other services such as piping, instrumentation, civil, structural, mechanical etc and also with a view to obtain as much uniform illumination as practicable, and to avoid objectionable shadows. Conduits shall be laid out by the Contractor to suit field conditions suitably interfacing with other services and as per directions of the Purchaser.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

On walkways, platforms and other outdoor area, lighting fixtures shall be located nearer to landing of stairs or ladders, gauges, flowmeters, panel boards and other equipment to provide proper illumination.

The minimum height of any lighting fixture shall be preferably not less than 2.5 meters above the floor level.

All outdoor cable terminations to outdoor junction boxes, panels, socket outlets etc. shall be through bottom or from side. Top entries for cables shall be avoided to avoid water entry. All cable glands for outdoor terminations shall be double compression type and the gland shall be covered with PVC or rubber boot shroud. All unused cable entries shall be plugged with suitable blanking plugs.

Mounting height of equipment shall be as under :-

Top of Switch Box : 1200 mm from FFL (Finished floor level)

Bottom of Lighting/Power Panel : 1500mm from FFL

5/15 Amp. Receptacle : 300mm from FFL unless otherwise specified
(1200 mm for process areas and industrial sheds)

Lighting fixture : As indicated in layout drawing

Exhaust fan : In the cutout provided / as indicated in Layout drawings.

Fixtures shall be firmly supported from the structures. Support clamps etc. may be bolted or welded to the existing steel work or metal inserts. In case of concrete structures, where metal inserts are not available, fixtures shall be suspended from concrete surfaces with the help of anchor fasteners. In such cases special care shall be taken to see that anchoring is firm. In places where ceiling fans are provided, lighting fixtures shall be suspended below the level of fan to avoid shadow effect.

Circuit cables in a group shall be cleated to structure by using galvanised strip clamps or cable run in cable trays wherever trays are available. Spacers and cleats shall be of required size to accommodate the cables. All hardware shall be galvanised. Underground lighting cables (in paved areas) shall be taken in suitable G.I. sleeves buried at a minimum depth of 300 mm from FFL. GI pipe sleeves shall be extended to 300 mm above FFL. Exact termination/layout of G.I. pipes (for protection of cables) shall be decided at site as per site convenience in consultation with Purchaser.


Wiring for all outlet sockets shall be done with 3 cores of equal sizes for phase, neutral and earth. The terminals of switch sockets shall be suitable to receive the size of wire specified.

All lighting fixtures shall be provided with terminal block with required terminals suitable for connection of wire up to 2.5 sq. mm copper conductor.

The cable shall be straightened after unwinding it from the drum. All cables be clamped/laid in straight run without any sag and kink.

For location where fan points are shown, fan hooks with junction box shall be provided during concreting. Where fan hooks and J.Bs. are provided separately JB shall be located within a distance of 300mm from hook for mounting of ceiling rose.

Industrial type plug sockets with 20A switch or rating as specified shall be provided at a height of 500mm from FFL for window AC units. Socket outlets and plugs for installation in MCC room, DG room, etc. shall be of industrial metal clad type.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Wiring for exhaust fans shall be terminated in receptacles as specified in layout drawing and the connection from receptacle to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires. Switch for exhaust fan shall be located in a separate switch board along with other switches

Conduit System

Surface or concealed conduit system of wiring shall be adopted, as specified in the drawings. Required number of pull boxes shall be used at intervals to facilitate easy drawing of wires. Separate conduit shall be run for lighting and power circuits. Further, conduits for Normal lighting/Emergency lighting/DC critical lighting shall be separate. Conduit layout shall be decided at site as per site conditions. Drop conduits for switch boards shall be decided by Contractor as per wall locations shown in Architectural drawings. All exposed run of conduits on surface, shall be vertical or horizontal.

Only threaded type conduit fittings shall be used for metallic conduit system. Pin grip type or clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed.

Conduit shall be of minimum 25mm dia. Maximum number of wires permissible in a conduit shall be seven for wire size of 2.5 sq mm.

The exposed outer surface of the conduit pipes, including all accessories forming part of the conduit system, shall be adequately protected against rusting. In all cases, bare threaded portion of conduit pipe shall not be exposed unless such bare threaded portion is treated with anti corrosive preservative or covered with approved plastic compound.

Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side. Where concealed wiring is done, junction boxes (65mm deep) shall be used so as to rest on shuttering properly. All conduit connections shall be properly screwed and Junction box covers shall be properly fitted so as to avoid entry of concrete slurry.


Where concealed wiring is to be adopted, conduits shall be laid in time before concreting of the slab. Pull wire (GI or steel) shall be provided inside conduit for the ease of wire pulling. The Contractor shall coordinate his work with other agencies involved in the civil works in such a way, that the work of the other agencies is not hampered or delayed. Vertical conduit runs shall be made in wall before plastering is done so as to avoid chasing. Where chases are made for conduit run Contractor shall fill these chases or any other openings made by them after completing the work and patch the surface. During installation, care shall be taken to see that proper covers are provided to prevent rusting of conduits. Locations of all point outlets, junction boxes shall be marked with brick powder or sand so that these are easily identified after shuttering removal. As built conduit layout drawing shall be submitted by Contractor after completion of the work.

All junction boxes, bends and other accessories shall be of the same material as that of conduit and shall have the same protective coatings.

After erection, the entire conduit system shall be tested, for mechanical and electrical continuity and shall be permanently connected to earth by means of approved type of earthing clamps.

Hazardous Area Installation

Wiring in hazardous area shall be done by using minimum 2.5mm² copper conductor armoured cable. Circuit wiring feeding hazardous areas shall be controlled by two pole switches/MCBs (for phase as well as neutral isolation).

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Correct type of lighting equipment (fixtures and JB's) with regard to hazardous protection as specified in the drawing shall be installed for the areas classified as Zone 1, Zone 2 etc.

The terminations in the junction boxes and the lighting fittings shall be done avoiding possibility of loose connections due to vibrations. After the terminations are made the cover of the junction boxes and the lighting fittings shall be closed properly with all bolts and hard wares in correct position, retaining its explosion and weather protections. In fixtures having double cable entries, both the entries shall be used for looping in and looping out connection, thus minimising the use of a separate junction box. Wherever separate control gear boxes (C.G. box) are provided looping in and looping out connections shall be through CG box, thus avoiding the use of a additional junction box. All unused cable entries shall be sealed with suitable plugs.

Circuit cables shall be firmly cleated in a group along columns/ beam/ladders/side channels/platform using 1.6mm thick GI saddles on 25x3 mm GI saddle bar at intervals of 400mm to 500mm for straight run and on either side close to bending and at both termination ends as per the directions of Purchaser. Where required, 3 or more of cables may be taken in slotted channel tray after obtaining approval of the Purchaser. Cables shall not be routed along hand rails.

Where fire proofing column/structures are encountered, all cabling shall be taken in GI pipes of required size and both ends shall be sealed, well before fire proofing is done. Similarly equipment such as lighting fixture, control gear box, lighting/ power panels, field call stations, junction boxes etc. shall be installed on suitable steel mounting frame/distance bracket, thereby avoiding direct contact with the concrete used for fire proofing.

Cable glands for terminating cable on flameproof equipment shall be of double compression FLP type. Any material/equipment specified to be supplied by Contractor for installation in hazardous areas, shall be tested by CMRI and duly approved by PESO Nagpur or DGMS Dhanbad or any other applicable statutory authority. All indigenous FLP equipment shall also have valid BIS license as required by statutory authorities.

High Mast Lighting


The high masts shall be installed on concrete foundations with the base plate bolted on to the anchor bolts. The high mast shall be painted with a coat of primer and two coats of aluminium paint, the second coat to be given just before handing over to the Purchaser. The high masts shall be numbered as per drawings. The high masts shall be connected to the plant earth grid at two points. Exact orientation of flood lighting fixtures shall be decided at site to achieve optimum utility of these fixtures.

EARTHING INSTALLATION

This consist of main earth conductor (grid conductor) forming a closed ring network with required number of earth electrodes connected to it to provide a common earth for electrical device and metallic structures. From each earth electrode two distinct connections shall be made of the main earth conductor. The earth plates shall be used for taking multiple earth connections to two or more equipment.

The earth conductors shall be laid in ground, along cable trays / cable trench / pipe rack etc as indicated on the earthing layout drawings. The location shown on the earthing layout drawings are indicative. The exact location of earth conductors in the filed shall be determined by Contractor in consultation with the Purchaser. Earth conductors shall be located avoiding interferences with other services such as piping, instrumentation, civil, structural, mechanical etc.

Where lined cable trenches are available, the earth conductor shall be laid in the trenches and shall be firmly cleated to the sidewall of concrete trenches using GI clamps at interval of 400 mm to 500 mm and near to the termination end. The earthing conductor shall run along one of the cable trays along a cable route. The earthing conductor shall be suitably cleated and electrically bonded to all the other cable trays on the same cable route at regular interval of 25 to 30 metre. The earthing for equipment shall be tapped from the main earth conductor and not from cable tray support structure.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Earth conductor when laid underground shall be at a depth of 600mm below finished grade level. Joints and tapping in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and shall be suitably protected by giving two coats of bitumen and covering with Hessian tape. Earth strip laid above ground shall be welded across straight through joints and joints shall be suitably protected by giving two coats of bitumen to avoid oxidation and insulation film formation of the strip surface. When two earth strips are to be jointed by means of welding, lap welding with an overlapping of strip equivalent to double the width of the strip and all four sides shall be continuously welded. All joints at tappings above ground shall be means of connector/ lugs. A minimum of two bolts of adequate size shall be used for this purpose. Earthing strip joints at earth plate and equipment shall be through GI bolts, nut etc.

Installation of Earth Electrodes

Earth electrodes shall be installed as shown on earthing layout drawings and installation details. The location shown on the earthing layout drawings are indicative. The exact location of earth electrodes in the filed shall be determined by Contractor in consultation with the Purchaser, depending on the soil strata and resistivity. Earth electrodes shall be located avoiding interferences with other services such as road, building foundation, column, pipelines etc. The civil area drawings shall be referred for this. The distance between two earth electrodes shall not be less than twice the depth of electrode.

Earth electrodes shall preferably be located in a moist soil which has a fine texture, grain size and distribution. Wherever practicable the soil be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes and soil packed by watering and ramming as tight as possible.

The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.

All earth electrodes shall be tested for earth resistance by means of standard earth test meter. The tests shall take place in dry months, preferably after a protracted dry spell.

The disconnect facility shall be provided for the individual earth electrode to check its earth resistance periodically.

Location of earth electrodes shall be marked by permanent markers for easy identification. All earth Electrodes shall be serial numbered and also marked on 'As Built' drawing for future reference.


Individual earth electrodes shall be provided for each lighting arrestor and flood light mast.

Earthing system provided for concrete paved area by other agency where applicable; shall be connected to the plant earthing system below ground by minimum two earth connections.

Connection

The earth system connections shall generally cover the following:

- Equipment earthing for personnel safety
- System neutral earthing
- Static and lighting protection The following shall be earthed.
- System neutral
- Current and potential transformer secondary neutral
- Metallic non-current carrying parts of all electrical apparatus such as transformers, switchboards, bus duct, motors, neutral earthing resistors, capacitors, UPS , battery charger panels, welding receptacles, power sockets, lighting / power panels, control stations, lighting fixtures etc.
- Steel structures/ columns, rail loadings platforms etc.
- Cable trays and racks, lighting mast and poles.
- Storage tanks, spheres, vessels, columns and all other process equipment.
- Fence and gate for electrical equipment (e.g. transformer, yard etc.)
- Cable shields and armour
- Flexible earth provision for Wagon, Truck

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

☐ Shield wire

Conductor size for branch connection to various equipment shall be as per Installation details unless otherwise stated on earthing layout drawings.

All process pipelines shall be bonded and earthed at the entry and exist points of battery limit of hazardous area. Earth continuity conductors across pipe flanges shall not be provided as per OISD 110.

Steel pipe racks in the process units and offsite area shall be earthed at every 24 metres.

Equipment / street light pole etc. located remote from main network may be earthed by means of individual earth electrode and earth conductor unless otherwise stated in specifications.

The main earthing network shall be used for earthing of equipment to protect against static electricity.

All medium and high voltage equipment (above 250V) shall be earthed by two separate and distinct connections with earth.

Plant instrument system clean earthing, UPS system clean / safety earth shall be separate from the electrical earthing system.

All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.

All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground wherever provided. Equipment foundation bolts shall not be used for earthing connection.

Earth connections shall be made through compression type cable welded lugs.

All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections and all connections adequately locked against loosening.

Lighting fixtures and receptacles shall be earthed through the extra core provided in the lighting circuit/ cable for this purpose.

The reinforcement of sub-station building and the sub-station floor shall be connected to main earth grid.

LIGHTNING PROTECTION INSTALLATION

Lightning protection shall be provided for the equipment, structure and buildings as shown on lightning protection layout drawings. Self conducting structures shall not require separate aerial rod and down conductors. These shall however be connected to the earthing system at two or more points as shown on earthing layout drawing. An independent earthing network shall be provided for lightning protection and this shall be bonded at least at two points with the main earthing network below ground. Lightning down conductor shall be brought to earth electrode in shortest straight path as feasible to minimize surge impedance. Aerial and down conductors shall be located avoiding interferences with other services such as ducts, pipes, equipment, supports etc.

3.0 LIST OF CONSTRUCTION EQUIPMENT

The contractor shall have all necessary construction equipment, tools and tackles and testing instruments to carry out the erection works and to commission the system as specified. These shall include but not be limited to the following, and these shall be brought to site by contractor before the start of work.

Equipment

1. Portable grinder.
2. Portable welding machine.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3. Portable gas cutting / welding set.
4. Pipe threading machine.
5. Pipe bending machine (hydraulic).
6. Portable drill machine suitable to take up drilling for different sizes as per requirement.
7. Dewatering pump sets (diesel driven).
8. Power Hacksaw.
9. Conduit Dyset.
10. Hydraulic crimping Machine
11. Hand crimping tool.
12. Portable electric blowers, vacuum cleaners.
13. Miscellaneous items such as slings, pulleys, tarpaulins, wooden sleepers, ladders, etc. as required.
14. Safety belts, safety goggles, and gloves.
15. Separate tool kit for each Electrician.

Test Instruments

1. Insulation tester 1000V hand driven.
2. Insulation tester 2500V motor/hand driven.
3. Insulation tester 5000V motor/hand driven
4. Phase sequence indicator.
5. Earth Resistance tester.
6. Single phase variac
7. 3 phases variac of adequate capacity.
8. Secondary injection testing kit (By Vendor).
9. Multimeter both analogue and digital
10. Portable Ammeters, Wattmeters, P.F. meters.
11. Portable Voltmeters.
12. Clip on meters of different ranges.
13. Tacho-meter.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

14. Kelvins double bridge for measurement of very low resistance.
15. D.C. high -pot test kit.
16. Oil filtration machine of adequate capacity.
17. LUX METER to measure illumination levels.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
HV & LV CABLES**

SPECIFICATION NO. -




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

CONTENTS

SL NO.	DISCRIPTION
SCOPE	
2.0	CODES AND STANDARDS
3.0	ENVIRONMENTAL CONDITIONS
4.0	DESIGN REQUIREMENTS
5.0	CABLE SPECIFICATION
6.0	GENERAL REQUIREMENT
7.0	CABLE DRUMS
8.0	TRANSPORTATION AND UNLOADING
9.0	DRAWINGS AND DOCUMENTS
10.0	INSPECTION
11.0	TYPICAL CALCULATIONS

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

1.0 SCOPE

- a. This specification is intended to detail the selection criteria of HV power & LV Power and control cables besides covering general requirements, testing at manufacturer's works, packing, transportation and receipt at site.
- b. Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:
1. Voltage grade, Conductor material, type of insulation and size of cables.
 2. Schedule of quantities of cables

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 CODES & STANDARDS


The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specifications, codes of practice of Indian Standards Institution, approved drawings and instructions of Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instruction of Engineer-in-Charge shall be binding.

The cables shall comply in design, material, testing and performance to the following codes and standards. The latest revision of the publication referred to shall apply.

- IS-1554 : PVC insulated (heavy duty) electric cables.
- IS-3961: Recommended current ratings for cables; PVC insulated and PVC sheathed heavy duty cables.
- IS-3975 : Mild steel wires, straps and tapes for armouring of cables.
- IS-5831 : PVC insulation and sheath of electric cables.
- IS-7098 : Cross-linked poly ethylene XLPE insulated PVC sheathed cables.
- IS-8130 : Conductors for insulated electric cables and flexible cords.
- IS-10418 : Drum for electric cables.
- IS- 10810 : Method of test for cables
- IS-13573 : Joints and terminations for polymeric cables for working voltages from 6.6 KV & including 33KV; performance requirements & type tests.

The cables and accessories shall conform to the provisions of Indian Electricity Rules and other statutory regulations as applicable.

2.1 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

2.2 In case any contradiction between various referred standards/specification/data sheets and statutory regulation etc the following order of priority shall be govern -

- i) Schedule of rates
- ii) Design Basis
 - iii) Scope of work/Job specification
 - iv) Data Sheet
 - v) Standard specification
 - vi) Codes & standard

3.0 ENVIRONMENTAL CONDITIONS

The cables shall be designed and calculated for continuous operation at full load under the climatic and environmental conditions as described in the "Design Requirements and Cable technical specifications".

4.0 DESIGN REQUIREMENTS

The cross section of all power cables shall be determined in accordance with the current demand of the linked power consumer, the maximum permissible voltage drop, the operating temperature, thermal short-circuit capacity, maximum cable loop impedance for earth faults and laying conditions.

Cable cross-sections shall be determined using the manufacturer's published data and the respective reduction factors according to installation conditions. The current-carrying capacities of power cables shall be calculated according to the type of operation, the conditions of installation and the ambient condition. The factors/parameters influencing cable sizing/ selection are as follows:

- Above ground or underground
- Installation / arrangement - e.g. for underground cables, is it directly buried or buried in conduit? For above ground cables, is it installed on cable tray / ladder, against a wall, in air, etc.
- Ambient or soil temperature of the installation site
- Cable bunching, i.e. the number of cables that are bunched together
- Cable spacing, i.e. whether cables are installed touching or spaced
- Soil thermal resistivity (for underground cables)
- Depth of laying (for underground cables)

Following points shall be taken into consideration during selection of cables:

- All LT power cables shall be 3.5 / 4 cores XLPE/PVC.
- Minimum size of the cables used in LT power feeders shall be 6 sq.mm for aluminium conductor and 4 sq.mm for copper conductor.
- Maximum cable size shall be 240 sq.mm for incomers to MCCs, PCCs etc.
- The minimum cable size selected for applications in the power circuits of cranes and other moving mechanisms shall be 6sq.mm with copper conductor.
- Flexible copper cables shall be used for power supply to vibrating mechanisms,
- For hoists, cranes, conveyors etc. shall be provided with flexible / festoon cable system, through butyl rubber / EPR insulated PCP/CSP sheathed flexible cables.
- Cables used for circuits of tacho generators, brakes, solenoids, field windings and secondary windings of measuring transformers shall be copper conductor with cross-sectional area not less than 2.5sq.mm.
- For control circuits, PVC insulated and PVC sheathed multicore cables with copper conductors having a minimum cross-sectional area of 2.5sq.mm shall be used. The number of cores may be standardized as 3, 5, 7, 10, 14, 19, and 24.
- Special screened/shielded cables shall be used for mA and mV signals.
- 20% spare cores shall be provided with minimum 1 spare core in multi-core control and signal cables



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- For calculating the current rating of LT power cables de-rating factor of 0.65 shall be considered.

HT Cable sizes for LT sub-station transformers

- The cable size shall be calculated based on the short circuit calculation considering breaker opening time of 0.25 seconds

Cable for Incomer of MCC / PDB / MLDB

- Cable size for incomer of MCC & PDB shall be selected on the basis of current rating corresponding to MD and voltage drop.
- Cable size for incomer of MLDB shall be selected on the basis of current rating corresponding to lighting transformer and voltage drop.

Cables for LT & HT Motors

- Cable size for LT motors shall be selected on the basis of rated nameplate current and starting & running voltage drop as per specification.
- Cable size for HT motors shall be selected on the basis of rated nameplate current, starting & running voltage drop as per specification and short circuit capacity of the system. The cable size shall be calculated based on the breaker opening time of 0.25 seconds.

Cables for Illumination System

- The minimum size of the cable for feeding power to SLDB or MCBDB having 32A incomer shall be 4x25sq.mm
- Cable size for SLDB (or MCBDB) to light fittings shall be 3x2.5sq.mm. or 4x2.5sq.mm as per the configuration of fittings.
- In case of concealed wiring, single core, PVC insulated, stranded copper conductor wire of size 2.5 sq mm in MS conduit shall be used. For utility sockets, cable size shall be 4sq.mm.

Cables for Automation System

- All Cables connecting I/Os from field to PLC or remote I/O panel shall be of stranded copper conductor of type YRY as per IS: 1554 and of size 2.5/1.5 sq.mm.
- Communication bus shall be laid in GI pipe. The route for redundant communication bus shall be different.

5.0 CABLES SPECIFICATION

5.1 HT Power Cables for Voltage up to 33kV.

Sl.No.	Parameter	Description
1.0	Voltage Grade	33 kV (UE)/ 11 kV (UE)/ 6.6 kV (UE) / 3.3 kV (UE) as applicable
2.0	Duty type	Heavy duty
3.0	No. of cores	3 cores



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

4.0	Reference standard	IS:8130 – 1984 IS:5831 – 1984 IS:3975 -1988 IS:1554, part - 1, 1988 IS:3961 (Part-II) - 1967. IS:7098 Part-I & II IEC-60502
5.0	Conductor type	Compact circular stranded (rm/V) aluminum conductor, with extruded conductor shielding of semi conducting material. Conductor construction as per IS 8130-1984.
6.0	Insulation type	XLPE insulated, with insulation shielding over individual cores, consisting of extruded semi conducting compound , followed by lapped semi conducting material and copper tape (non magnetic) metallic screen , cores stranded together with a holding tape provided with a common covering of extruded inner sheath of type ST2 compound . The cable shall conform to IS:7098(Part-2)-1985.
7.0	Armour	Galvanized steel wire armoured. For multi core cables, armouring shall be applied over the inner sheath of flat steel wires (strips) . Round steel wire armouring can also be offered. For single core armoured cables non-magnetic armour consisting of hard drawn flat or round aluminium wires shall be provided.
8.0	Outer sheath	PVC outer sheathed of type ST2 compound. Black in colour. Suitable chemicals shall be added into the PVC compound of the outer sheath to protect the cable against rodent and termite attack.
9.0	Miscellaneous	Copper screen shall be suitable to carry 1 KA E/F current for one second.
10.0	Temp. rise on continuous load	90 deg.C
11.0	Oxygen index of outer sheath material for XLPE Cable	Shall not be less than 29 at 27 ± 2 deg. C.
12.0	Temperature index	Not below 250°C.
13.0	Max. conductor withstand temperature during short circuit.	250°C

5.2 LT Power Cables of 1.1kV Voltage grade.

Sl.No.	Parameter	Description
1.0	Voltage Grade	1.1 kV grade
2.0	Duty type	Heavy duty



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3.0	No. of cores	<ul style="list-style-type: none"> - 3.5 / 4 core cables shall be used for motor feeders. - For other consumers or for power supply to other panel 4 core (upto conductor size of 50 sq.mm) or 3.5 core (for conductor size beyond 50 sq.mm) cables shall be used.
4.0	Reference standard	IS:8130 – 1984 IS:5831 – 1984 IS:3975 – 1988 IS:1554, part - 1, 1988 IS:3961 (Part-II) - 1967. IS:7098 Part-I & II IEC-60502
5.0	Conductor type	<ul style="list-style-type: none"> - Plain aluminium conductor. - All power cables of size 10 sq.mm and above shall have standard sector shaped (sm) or compact circular stranded (rm/V) or circular stranded (rm) aluminum conductors as applicable. - The conductors will be H2 or H4 grade. - The solid conductor shall be class - 1 and the stranded conductor will be class - 2. - The conductors shall be solid for conductor of nominal area upto and including 6 sq. mm. and stranded beyond 6 sq. mm. Conductors of nominal area less than 25 sq. mm. shall be circular or shaped. Cables with reduced neutral conductor shall have sizes as per Table 1 of IS 1554 (Part-1) -1988.
6.0	Insulation type	<ul style="list-style-type: none"> - XLPE insulation - The insulation compound shall be conforming to IS:7098 (Part I) - 1988.
7.0	Inner sheath	<ul style="list-style-type: none"> - For armoured / unarmoured cables a tough inner sheath of heat resisting PVC compound

		(wrapped / extruded as per size),Type ST2 as per IS 5831 . <ul style="list-style-type: none"> - Black in colour.
8.0	Armour	<ul style="list-style-type: none"> - Galvanised steel wire armour shall be used for 3Cx10 sq.mm / 4Cx6 sq.mm cable. - Galvanised flat steel wires (strips) armour shall be used for bigger size cables. - Single core armoured cables are provided with non-magnetic armour consisting of hard drawn flat or round aluminium wires.
9.0	Outer sheath	<ul style="list-style-type: none"> - For armoured / unarmoured cables a tough outer sheath of heat resisting PVC compound (Type ST2 as per IS 5831) . - Black in colour .



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

10.0	Miscellaneous	<ul style="list-style-type: none"> - Minimum cross - sectional area of the power cable shall be 6 sq.mm in case of aluminium conductor and 2.5 sq.mm in case of copper conductor. - Power cables shall be selected from core sizes of 6, 10, 16, 25, 50, 70, 120, 150, 240 & 300 sq.mm (Aluminium conductor).
11.0	Temp. rise	Shall be limited to 90 deg.C.
12.0	Core identification	<ul style="list-style-type: none"> - Cable identification will be provided by embossing on the outer sheath the following: <ul style="list-style-type: none"> • Manufacturer's name & trade mark • Voltage grade • Year of manufacture • Type of insulation • R,Y,B for phases . • Black for neutral (fourth core)

5.3 LT Control Cables of 1.1kV Voltage grade.

Sl.No.	Parameter	Description
1.0	Voltage Grade	1.1 kV grade
2.0	Duty type	Heavy duty
3.0	No. of cores	As per requirement .
4.0	Reference standard	IS:8130 – 1984 IS:5831 – 1984 IS:3975 -1988 IS:1554, part - 1, 1988 IS:3961 (Part-II) - 1967. IEC-60502
5.0	Cross sectional area	Shall be 1.5 / 2.5 sq.mm.
6.0	Conductor type	Solid annealed circular stranded copper conductor.
7.0	Insulation type	PVC Type- C insulated
8.0	Inner and outer sheath	<ul style="list-style-type: none"> - Type ST-2 PVC shall be used for inner sheath . - Type ST-2 PVC shall be used for outer sheath .
		- Both inner and outer sheath shall be extruded type upto 7 core and after 7 core inner sheath shall be wrapped ..
9.0	Armour	- Galvanised steel wire armour / galvanised steel strip
10.0	Spare Cores	- 3, 5 and 7 cores cables shall have at least one spare core, cables with 10 core and above shall have at least 2 spare cores.
11.0	Miscellaneous	<ul style="list-style-type: none"> - The Tenderer shall furnish necessary calculations to show that the selected cable satisfy the criteria including for voltage drop. - Cables for temperature detectors shall be screened type of required technical parameters with core size not less 1.5 sq.mm.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

12.0	Core identification	<ul style="list-style-type: none"> - Cable identification will be provided by embossing on the outer sheath the following: <ul style="list-style-type: none"> • Manufacturer's name & trade mark • Voltage grade • Year of manufacture • Type of insulation - Cores of the cables upto 5 cores shall be identified by colouring of insulation. - For cables having more than 5 cores, core identification shall be done by numbering insulation of core sequentially. - All the numbers shall be of same colour, which shall contrast with the colour of insulation. - Numbers shall be written in figures and words both - The numerals shall be legible and indelible. - The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. - When number is a single numeral a dash shall be blacked underneath. - If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. - The spacing between consecutive numbers shall not exceed 100 mm.
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5.4 LT Power Screened/special cables.

Sl.No.	Parameter	Description
1.0	Voltage Grade	1.1 kV grade
2.0	Duty type	Heavy duty
3.0	No. of cores	As per requirement .
4.0	Cross sectional area of conductor & Armouring	<ul style="list-style-type: none"> - Shall be 1.5 sq.mm & Armoured . - For weighing system 1.0 sq mm un-armoured
		cables in GI conduit from field to controller panel shall be provided.
5.0	Conductor type	<ul style="list-style-type: none"> - Solid annealed circular stranded copper conductor. - For twisted pair cables , the conductors shall be of stranded tinned copper having proper flexibility to provide limpness and extended flex-life as required for these small diameter cables.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

6.0	Insulation type	<ul style="list-style-type: none"> - PVC insulated, Type A - Type ST-1 PVC shall be used for inner sheath. - Both inner and outer sheath shall be extruded type. - Outer sheath made of PCP (Chloroprene rubber), abrasion resistant, oil resistant and flame retardant conforming to IS:434 –1964 (Part - I), as amended upto date.
7.0	Screen	<ul style="list-style-type: none"> - Tinned annealed copper mesh over metallised tape , in a close woven braid .
8.0	Shielding	<ul style="list-style-type: none"> - Special aluminium foil to provide 100% shield coverage for optimum protection against radiated interference and ingress of audio and radio frequencies. - It shall have shorting fold for metal to metal contact and isolation fold to prevent adjacent shields from shorting to one another, so as to improve the voltage breakdown characteristics. The drain wire shall be of stranded tinned copper wire of 0.518 sq. mm. (20 AWG) cross-section.
9.0	Spare Cores	<ul style="list-style-type: none"> - 20% spare cores but not less than 2 spares shall be provided in all the multi core cables .
10.0	Reference standard	As per relevant IS with latest amendments
11.0	Miscellaneous	<ul style="list-style-type: none"> - The Tenderer shall furnish necessary calculations to show that the selected cable satisfy the criteria including for voltage drop. - Cables for temperature detectors shall be screened type of required technical parameters with core size not less 1.5 sq.mm. - The special twisted paired cables shall be of the type to provide balanced signal transmission and shall have good noise immunity.
12.0	Core identification	<ul style="list-style-type: none"> - Cable identification will be provided by embossing on the outer sheath the following: <ul style="list-style-type: none"> • Manufacturer's name & trade mark • Voltage grade • Year of manufacture • Type of insulation - Cores of the cables upto 5 cores shall be identified by colouring of insulation. - For cables having more than 5 cores, core
		<ul style="list-style-type: none"> identification shall be done by numbering insulation of core sequentially. - All the numbers shall be of same colour, which shall contrast with the colour of insulation. - Numbers shall be written in figures and words both - The numerals shall be legible and indelible. - The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. - When number is a single numeral a dash shall be blacked underneath. - If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. - The spacing between consecutive numbers shall not exceed 100 mm.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

5.5 Flame retardant low smoke (FRLS) cables.

Sl.No.	Parameter	Description
1.0	Voltage Grade	1.1 kV grade
2.0	Reference standard	Category AF as per IS : 10810 ASTM-D 2863 (Critical Oxygen Index) ASTM-D 2863 (Temperature Index) ASTM-D 2843 (Smoke density) IEC 754-1 (Acid gas generation) IEEE-383 (Flammability test on group of cables) Swedish chimney test SS 424175, class F3. (Flammability test) IEC 332-1 (Flammability test) IEC 332-3 (Flammability test) IS 5831 (Fire resistant test)
3.0	Duty type	Heavy duty
4.0	No. of cores	Single or multicore as per requirement
5.0	Cross sectional area	As per requirement .
6.0	Conductor type	Annealed tinned copper conductor
8.0	Insulation type	XLPE insulation
11.0	Sheath	Specially designed with thermoplastic or thermosetting materials , superior resistance to ignition and flame propagation with smoke emission and toxicity or corrosive characteristics Flame retarded Oil resistant
12.0	Armouring	GI wire / strip armoured as per requirement and size (as specified in respective TS)
13.0	Test values	Critical Oxygen Index : Minimum 29 Temperature Index : Minimum 250 deg. C Smoke density : Minimum average light

		transmission of 40%
	Acid gas generation	: HCl gas released 20% maximum
	Flammability test on group of cables test	: As per standards mentioned : As per standards mentioned
	Fire resistant test	: As per standards mentioned

5.6 Details to be furnished in datasheet of HT & LT Cables:

- i) Name of manufacturer
- ii) Type
- iii) Applicable standards
- iv) Voltage grade
- v) Maximum temperature of conductor
 - Continuous rating
 - Short circuit withstand rating
- vi) Conductor
 - Material & type
 - Type & shape of conductor
 - Cross sectional area
 - Number and diameter of wire in each conductor
- vii) Insulation
 - Material & type
 - Nominal thickness
 - Identification of cores
- viii) Laying up
 - Direction of lay
- ix) Inner sheath
 - Material & type
 - Minimum thickness
- x) Armour
 - Material & type
- xi) Outer sheath
 - Material & type
 - Colour
 - Minimum thickness
 - Embossing/printing
 - Diameter of cable
 - Sequential length marking
- xii) General
 - Total quantity
 - Packing length
 - Net weight
- xiii) Acceptance and routine tests
 - Tensile strength of insulation & sheath
 - Elongation at break of insulation & sheath
 - Volume resistivity
 - DC Resistance of conductor at 20°C
 - High voltage at room temperature
- xiv) Other parameters
 - Short circuit rating of conductor for 1 sec
 - Minimum permissible bending radius
- xv) Current rating
 - Direct in ground
 - In air
 - In Duct



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

6.0 GENERAL REQUIREMENT

The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installations.

They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE /PVC insulated L.T. power cables shall withstand without damage a 3 phase fault current for 1 second as specified in "Design Basis" at rated conductor temperature (70° C for PVC insulated cables and 90° C for XLPE insulated cables).

The XLPE insulated cables shall be capable of withstanding a conductor temperature of 250°C during a short circuit without any damage. The PVC insulated cables shall be capable of withstanding a conductor temperature of 160°C during a short circuit.

The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects.

Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.

The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.

When armouring is specified for single core cables, the same shall consist of aluminium wires/strips.

7.0 CABLE DRUMS

7.1 Cables shall be supplied in returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.

7.2 Standard lengths for each size of power and control cables shall be 500/1000 meters. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard

drum length. The owner shall have the option of rejecting cable drums with shorter lengths. However if shorter length of cable (Not standard as specified) is required shall be provided by the contractor in drums.

Maximum, One (1) number non standard length of cable size(s) may be supplied in drums for completion of project.

7.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

7.4 Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stencilled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

7.5 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

8.0 TRANSPORTATION AND UNLOADING

All cables shall be shipped and transported on cable drums of adequate size. Drums shall be lifted by means of a crane or by means of a loading ramp. Throwing and dropping down of cable drums shall be strictly avoided. In order to prevent drums moving during transportation, these must be securely wedged to prevent movement. Before unloading it is necessary to verify that the drum is received in proper condition. The directional arrow of the drums has to be observed during rolling. Empty cable drums have to be stored on a suitable central store place. Retransport to the cable manufacturer of returnable drums is the Contractor's responsibility.

9.0 DRAWINGS AND DOCUMENTS

Following minimum information shall be furnished with bid:

- a) Data sheet for cables
- b) Type Test Reports of cables
- c) Catalogues of cables

The following drawings (in three sets) shall be submitted for approval/review within 3 weeks of award of contract.

- a) Data sheet for cables
- b) Type Test Reports of cables

10.0 INSPECTION

Inspection and testing of equipment shall be carried out by the owner/ consultant at the manufacturer's works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approval drags. and reference national/ international standards.

The inspector shall have free access to the manufacturer's works for the purpose of inspecting the process of manufacture in all its stages and he shall have the power to reject any material which appears to be unsuitable description or of unsatisfactory quality. The vendor shall give at least 2 weeks advance notice to the purchaser regarding the date of testing to enable them or their representative to witness the tests.

The contractor shall submit Quality Assurance Plan (QAP) for respective equipments within 3 weeks of award of contract.

QAP shall be prepared and furnished by the contractor in PMC Form No. 11.20(4.4) F-10 along with their internal in process quality checks.

After completion of manufacture of cables and prior to despatch, the cables shall be subjected to type, routine, acceptance and special tests as per the approved QAP. Purchaser / Consultant reserve the right to witness all tests with sufficient advance notice from vendor.

All routine tests, acceptance tests, type tests and additional type tests for improved fire performance shall be carried out on cables as per IS:1554 Part 1 and IS:7098 Part – 2 and international standards as may be applicable.

Routine test and type test certificate shall be furnished for review. Acceptance test shall be witnessed by owner/consultant.

The following special tests may be performed on the cables as per sampling plan and as may be applicable as per approved QAP. These tests will be witnessed by Purchaser / Consultant before despatch of cables.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- a. Accelerated water absorption test for insulation as per NEMA – WC – 5. (For PVC insulated cables) and as per NEMA WC – 7 (for XLPE insulated cables). Sampling for this test to be done randomly and once for each size per order wise provided outer sheath remains same.
- b. Dielectric Retention Test: The dielectric strength of the cable insulation tested in accordance with NEMA WC – 5 at 75 +/- 1 deg C will not be less than 50% of the original dielectric strength (For PVC insulated cables.) Test certificates with respect to this test from recognized testing laboratory to be furnished for review by purchaser/ consultant before inspection of cables. In case test certificates are not available, test to be conducted by the manufacturer at his own cost in any recognized test laboratory before inspection of cables.
- c. Oxygen index test: The test will be carried out as per ASTM D 2863 or applicable Indian Standard. Sampling to be done for every offered lot / size as per sampling plan.
- d. Flammability test: The test will be carried out on finished cable as per IS-10810 (Part 61 & 62). Sampling for these tests to be done randomly once for each size per lot provided outer sheath remains same.
- e. Test for rodent and termite repulsion property: The vendors will furnish the test details to analyse the property by chemical method. Sampling will be done for every offered lot / size as per sampling plan.

11. TYPICAL CALCULATIONS: (For sizing and design)

a) Selection criteria for HV/MV cable size for primary distribution:

- i) Temperature of conductor just prior to short circuit:
 - 1) With XLPE insulation - 90 Deg. C
 - 2) With PVC insulation - 70 Deg. C
- ii) Maximum permissible conductor temperature during short circuit:
 - 1) With XLPE insulation - 250 Deg. C
 - 2) With PVC insulation - 160 Deg. C
- iii) Volumetric specific heat of the conductor:
 - 1) With Aluminium conductor - 2.5 x 10 J/Deg. C/MM
 - 2) With Copper conductor - 3.45 x 10 J/Deg. C/MM
- iv) Reciprocal of temperature co-efficient of resistance at 9 Deg. C:
 - 1) With Aluminium conductor - 228
 - 2) With Copper conductor - 234.5

Short circuit current rating at different duration may be calculated as – $I_{sh}(\text{for } t \text{ duration}) = I_{sh}(\text{for } 1\text{Sec.}) \sqrt{t}$ (kA)


t = Time duration required to be calculated of short circuit in Sec

Formula for calculating HT Cable size:

With Aluminium cond./XLPE insulated cable = $I_{sh} \sqrt{t} / 0.094$ With

Copper cond./XLPE insulated cable = $I_{sh} \sqrt{t} / 0.143$

b) Calculation for number of runs of incoming cable: Maximum demand (MD) on MCC = (Total working load x LF)/DF Where

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

LF – Load factor
DF – Demand factor

Current based on maximum demand (IM)= (KW \times 1000)/(1.732 X V X pf) Current rating as per catalogue (In air) for selected size of cable - IC Derated current rating (ICD) = Derating factor X IC
Minimum no. of runs (n) = IM / ICD

c) Voltage drop calculation:

Voltage drop of cable = ($\sqrt{3}$ x IM x Zcab x L) / n Volts. Where

IM - Current based on maximum demand Zcab – Impedence of cable

L – Route length of cable N – no. of runs



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
PDB PANEL**

SPECIFICATION NO. -



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

C O N T E N T S

SL. NO.	DESCRIPTION
1.0	INTENT
2.0	CODES & STANDARDS
3.0	TECHNICAL REQUIREMENTS
4.0	AUTOMATIC POWER FACTOR CORRECTION EQUIPMENT
5.0	CONTROL EQUIPMENT
6.0	FEEDER TYPE
7.0	SPECIAL TOOLS
8.0	PAINTING
9.0	TESTS
10.0	DRAWINGS
11.0	PACKING
12.0	COMPLETENESS OF EQUIPMENT



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 INTENT

- a. The intent of this standard specification is to define the general requirements for design, manufacture, assembly and testing at manufacturer's works, packing, transportation and receipt at site with all materials and accessories of PDB Panel.
- b. **Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:**

1. **Details of PDB – Single /double front, Draw out/ Non-drawout, Busbar details – Alumimium/copper etc.**
2. **Single incomer/ double incomer with buscoupler along with ratings.**
3. **Outgoing feeder details (Ratings & Quantity)**
4. **Make list of PDB and its components**
5. **Quantity & location of PDB**

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 CODES & STANDARDS

- IS: 375 - Marking and arrangement for switchgear busbars, main connections and auxiliary wiring
- IS: 722 - AC Electric meters
- Degree of protection provided by enclosures for low voltage switchgear and control gear
- IS: 2705 - Current transformers
- IS: 3156 - Voltage transformers
- IS: 3231 - Electrical relays for power system protection
- General requirements for switchgear and controlgear for voltages not exceeding 1 000 volts ac or 1 200 volts dc
- Specification of low voltageswitchgear and controlgear assemblies
- Code of Practice for selection, installation & maintenance of switchgear & controlgear.
- IS: 13947 - Specification of low voltage switchgear and controlgear
- IEEE - Recommended practice for electrical power distribution (Std. 141) for industrial plants

3.0 TECHNICAL REQUIREMENTS

3.1 Construction features

- 415V, 3 phase, 4 wire, 50 kA (short time rating for 1 sec.) indoor type.
- Single front/ double front design(as per TS), Draw –out / Non-draw out (as per TS), free standing, compartmentalized, floor mounting type suitable for both front and rear access.
- The panel shall be extendable on both sides at site through provision of coupling holes at bus end & removable type side end covers.
- Unless specified in TS, the PDB shall have one incomer.
- Incoming Circuit breakers (ACBs – 800A & above / MCCBs from 500A upto 630A with contactor) shall



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

be mounted on fully draw-out truck with service, test and isolated positions and complete with following safety interlocks and safety shutters with padlock facility;

- It shall not be possible to move the truck in or out of cubicle when the breaker is closed.
- CB compartment door shall be mechanically interlocked so that it will not be possible to close the CB in plug position when the door is open.
- It shall not be possible to push the truck in close position if either of the safety shutter is not free and not in close position.
- Incomer MCCB below 500A rating shall be a non-drawout panel.
- Outgoing feeders shall be drawout / non-drawout type as per TS.
- Shall have an integral base channel.
- A transport section shall not exceed 3 vertical panels (Limited to 2400 mm).
- Rear face of each panel cubicle shall be openable and accessible for maintenance purpose. Panel shall have removable type bolted door on the rear side.
- Lifting facility shall be provided for each section.
- Dust & vermin proof design.
- Degree of protection for enclosure kept in a premise shall be IP 52 as per IS: 13947 – 1993 Part – 1.
- Incomer shall have analogue type of Voltmeter & Ammeter with selector switches. All feeders shall have ON/OFF/TRIP lamps. Each Incomer panel shall have 3 nos lamps for R/Y/B and 6 nos lamps for Breaker ON/OFF/TRIP and for breaker fault conditions.
- Shall have isolated busbar chamber for main busbar at the top, running through out the length of the board. Chamber shall have removable cover.
- Cable alley shall have sufficient space for aluminium power cables and bottom cable chamber shall be left free completely isolated from the vertical busbars.
- Busbars shall have same cross section throughout the length. Rating of the neutral busbar shall be 50% of the main busbar. Earth bus bar shall run in bottom chamber throughout the length of the panel.
- Polyurethane/ Neoprene gaskets shall be used for cable alley doors, busbar chamber covers to ensure tightness and making it dust proof.
- Feeder module doors and cable alley doors shall open in opposite direction for providing more working area for maintenance purpose.
- Each feeder module shall have door interlock, defeat interlock and padlocking facility.
- All outgoing feeders from PDB's shall be TPN MCCB with minimum 2 NO+2NC auxiliary contacts.

3.2 Busbars & Supports

- Main busbars shall be made of high conductivity EC grade aluminium alloy equivalent to E91E WP (IS-5082/1981) or electrolytic copper as per IS-1897-1983.
- Three phase, neutral (with atleast 50% rating of main buses) and continuous earth bus. Bus bar shall be provided with proper grade & colour of heat shrinkable sleeve.
- Rating of horizontal buses shall be same as that of incomer circuit breakers and vertical run shall be same as that of outgoing breaker rating.
- Temperature rise of bus bars shall not be more than 40 deg. C above an ambient of 50 deg. C.
- Three phase and Neutral bus shall have facility for connection with earth bus.
- Shall be heat shrinkable PVC shrouded except at the points of tap-off. The bus bars shall be colour coded for phase identification.
 - All incoming and outgoing bus bars shall be TP&N type and shall be sleeved.
- Busbars shall be housed in totally enclosed compartments (Bus bar chambers) having removable type covers for easy maintenance.
- Power and control bus bars shall be segregated. Main bus bars shall run throughout the length of transport section and vertical bus bars throughout the height of PDB.
- Busbar joints shall be of bolted type with suitable spring washers to ensure tight fittings. Bolts and washer shall be galvanized or cadmium plated.
- GI earth strip of size 50 x 6 mm or equivalent shall be run at the bottom of PDB with a provision of a link for connecting to neutral bus bar.
- Provision shall also be made for terminating the 4th core of incoming & outgoing cables.
- Bus bars shall be sized for the current rating specified (with temperature derating) to withstand a short



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

circuit current of 50kA for 1 sec.

- Bus bar supports shall have adequate mechanical strength, high dielectric strength, and low moisture absorption characteristics.
- Bus bar supports shall be rigidly held to the frame work of PDB and shall be so spaced as to ensure rigid support for bus bars.
- Bus bar supports shall be designed to withstand thermal and dynamic stresses resulting from specified short circuit current.
 - Min. clearance between live parts shall be 25 mm and live to earth 19mm.
- All core type CTs mounted on bus bars shall be supported separately and not supported on bus bars. CT secondary-connecting cables shall be properly dressed and clamped such that these do not hang loose / pass directly over bus bars.

3.1 Circuit Breaker

3.3.1 Electrical Features

- Air break triple pole (4 pole in case of DG power incomer) drawout type conforming to IS 13947 for incomers & buscoupler for ratings of 800A & above.
- MCCB TPN, air break type with independent manual quick make and quick break type for incomer ratings of upto 630A and all outgoing feeders. MCCB shall withstand the fault current envisaged for 415V system. MCCB shall have set point adjustable feature for instantaneous thermal overload & shall have trip coil.
- Under voltage release provision shall be kept in ACB.
- Electrically operated mechanism for incomers & Bus-couplers. Manual operated mechanism for outgoing feeders or as specified
- Incomer shall have analogue type of Voltmeter & Ammeter (144 X 144 sq.mm) with selector switches. All outgoing feeders shall have ON/OFF/TRIP lamps with ammeters of 96 X 96 sq.mm.
- All outgoing feeders shall have TPN.
- Rated continuous current as specified:
 - Symmetrical breaking capacity and 1 second rating of the breaker not less than the system short circuit level specified.
 - Making capacity 2.55 times breaking capacity.
- Auxiliary contacts : 4 NO + 4 NC minimum, convertible from NO to NC and vice versa at site.

Ratings :

Continuous	10 amps
AC 11	4 amps at 240 V
DC 11	0.5 amps at 110 V

3.3.2 Moulded Case Circuit Breaker (MCCB)

MCCB shall conform to IS/IEC 60947-2 and the rating shall be as per SLD with ICS=ICU=100% for the complete range. MCCBs must be suitable for "Positive Isolation" as per IEC 60947-2 and should have Class-II Front Facia as per IEC 60441. MCCB rated upto 250 A shall have Thermal Magnetic release or Microprocessor based release with variable O/L, S/C & E/F settings. Accessories should be



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

continuously rated with Shunt Trip Coils and shall be snap fit type and should be common throughout the range. MCCB shall have Cross Bolted Termination to withstand higher short circuit Levels. Operating handle, door interlock and padlocking at ON/OFF position shall be provided. At least 1 NO and 1 NC auxiliary contacts shall be provided.

3.3.3 Air Circuit Breaker (ACB)

3.3.3.1 Electrical Features


- Air break TPN (4 pole in case of DG power in comer) drawout type conforming to IS 13947.
 - Motor operated spring charge mechanism
 - Rated continuous current as specified.
- Symmetrical breaking capacity and 1 second rating of the breaker not less than the system short circuit level specified.
 - Making capacity 2.55 times breaking capacity.
 - Performance category : P2
 - Auxiliary contacts : 4 NO + 4 NC minimum, convertible from NO to NC and vice versa at site.

Ratings :

Continuous	10 amps
AC 11	4 amps at 240 V
DC 11	0.5 amps at 110 V

3.3.3.2 Operating Mechanism

- Electrically operated mechanism for incomers & Bus-couplers
- Manual operated mechanism for outgoing feeders or as specified with MCCB + Contactor as per SLD/TS.
- Spring charged stored energy mechanism to ensure high speed closing and tripping independent of the operating forces.
- Anti pumping and trip free feature
- Emergency tripping by mechanically operated trip push button (shrouded to prevent accidental closing) acting directly on the trip bar.
- Closing operation of the breaker to charge the tripping spring, ready for tripping.
- Mechanical indication to show :
 - Closing spring charged
 - Breaker ON/OFF/TRIP
 - Breaker to close only when spring fully charged
 - Non-reset type operation counter
 - For manually operated breakers (if specified).
 - Independent manual charging of closing spring and closing by handle.
- Alternatively, closing by mechanical push button with spring previously charged by handle.
 - For electrically operated breakers :
 - Charging of closing spring by motor
 - closing by closing coil
- spring charging motor and closing coil suitable for rated control voltage (240 AC unless otherwise specified).
 - One opening and one closing operation without control supply.
 - Provision also for manual closing with spring charging motor automatically decoupled as soon as charging handle is inserted.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

3.3.3.3 Drawout Features

- 3 distinct positions viz. service, test, and isolated with the door closed.
- Mechanical position indication and locking/latching facility for all 3 positions.
- Power connections -self aligning, plug-in type.
- Control connections - sliding or plug socket type, mechanically coded, to prevent wrong insertion.
- Automatic safety shutters to prevent accidental contact with live parts when the breaker is withdrawn.

3.3.3.4 Safety Interlocks

- It shall not be possible to close the breaker in any intermediate position other than the 3 fixed positions.
- With the breaker closed, it shall not be possible to rack it in from any of the 3 position to another.
 - Mechanical stopper to prevent accidental falling while withdrawing.
- It shall not be possible to rack in the breaker from isolated to 'test' position with the door open together with provision for defeat of this interlocking, however, it shall be possible to close the door only when the breaker is brought back to 'isolated' position.
- It shall be possible to open the door only when breaker is OFF and is in 'Isolated' position.
 - Remote closing of breaker is not permitted with door open.
- Insertion of breaker into 'Service' position shall not be possible if the shutters are not free.

3.3.3.5 Microprocessor based releases General

- The control unit shall be interchangeable on site for adaptation to changes in the installation.
- Sensors shall be non-magnetic or of the Rogowsky type for accurate current measurements.
 - The control unit shall measure the true RMS value of the current.
- The control unit shall comprise a thermal memory to store temperature-rise data in the event of repeated overloads or earth faults. It shall be possible to disable this function if necessary.

Protection

The control unit shall offer the following protection functions as standard:

1. Long-time (LT) protection with an adjustable current setting and time delay;
2. Short-time (ST) protection with an adjustable pick-up and time delay;
3. Instantaneous (INST) protection with an adjustable pick-up and an OFF position.

- Digital Microprocessor based relay shall be used to obtain data processing regarding protection.
- It shall display the phase current with highest load.
- It shall also express the true energy content of the current.
- Current and time-delay settings shall be indicated in amperes and seconds respectively on a digital display. Acknowledgement that the setting change should translate to the trip threshold.
- Earth-fault protection with an adjustable pick-up and time delay shall be provided if indicated on the single-line diagram.

3.3.3.6 Communication

- The circuit breaker shall be capable of communicating the following data via a bus:
 - Circuit-breaker status (open/closed, service/test/isolated, tripped on a fault, ready to close);
 - Control-unit settings;
 - Tripping causes;
 - The measurements processed by the control unit: current, voltage, frequency, power
- It shall be possible to remotely control the circuit breaker. All Protection parameters are adjustable from Remote.
- RS-485 Standard serial interface shall be provided for communication of microprocessor based relay
- It shall be possible to remotely modify circuit-breaker settings:



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- Settings within the range defined by the switches on the front panel of the control unit;
- Settings of the protection functions and the alarms.
- Communications functions shall be independent of the control unit

3.2 Internal Panel Wiring & Terminal Blocks

- Suitable provision shall be made to terminate control / power connections near the respective module. The terminals selected shall be suitable for the termination of armoured cables, as per the details of cable required. Adequate space shall be kept for cabling.
- Feeders up to 100A shall be terminated to terminal block located in cabling chamber and feeders above 100A rating shall be terminated directly to suitably staggered taped bus bars.
- PDB shall be completely factory wired, ready for connecting to equipment.
- Power circuit wiring shall be with 1100 V grade single core stranded, PVC insulated copper cable of minimum 4 sq. mm or aluminium cable of 6 sq.mm..
- Control circuit wiring shall be with 1100 V grade multi strand, PVC insulated copper cable of 2.5 sq. mm.
- Internal control wiring shall be laid in PVC ducts with detachable snap - on covers and there shall be enough length to avoid the necessity to stretch the cables for door movement/connection, disconnection or changing.
- Wires identified at each end in accordance with schematic diagrams by interlocked type ferrules.
- Necessary cable clamping arrangement shall also be provided in the cable alley/chamber inside compartment on perforated sheet steel section.

- All connections external to a feeder, all the auxiliary contacts of the LT breaker, and all spare contacts of the relays shall be wired on to the terminal blocks.
- Interconnection between panels of adjacent shipping sections to be brought out to a separate terminal block, wires for interconnection properly labeled, looped and bunched inside the panel for connection at site.
- All terminals, as well as terminations, at various control devices inside the compartment shall be provided with interlocking type ferrules having engraved numbers. Terminals having connections from other modules shall be marked with red ferrules.
- There shall be no joints or tappings between two terminations. No more Than two connections shall be made to any terminal.
- 20% spare terminals shall be provided in each control terminal block.
- The wiring shall be terminated in the respective terminal with suitable crimp type sockets.
- Interlocking type ferrules for identification shall be provided.
- All spare contacts to be wired to terminal block.
- Interpanel wiring shall be through horizontal bus bar chamber.
- All holes or tubes for wiring runs shall be bushed and shall have room for reasonable additions.
- All power cable terminal blocks / boards shall be stud and nut type with phase barriers.
- For higher rated feeders, suitable staggered extension links shall be provided to permit direct termination of cables.
- Cable supports / clamps shall be provided in cable alley.
- Removable cable gland plate shall be provided.

- All cable termination nut / bolts and washers (for all cables at panel bus bar /link inside all the supplied panels must be supplied as part of Tenderer's panel supplier's scope.
- Double compression type GI / brass glands, accessories including tinned copper lugs to outgoing cable sizes to be supplied loose.
- The color-codes for the wires shall be as follows:

415V, 3phases

Red, yellow &
blue

Neutral

Black



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Earth	Green
Single phase - line	Red
110V AC - line	Brown
24V DC +ve	Orange
-ve	Black

3.3 Control Transformers

415V/230V Control transformers of adequate rating (Minimum 2.5 kVA each) shall be provided for 230 V AC control supply for each PDB. Higher rating shall be selected based on actual requirement with 50% margin and voltage drop in control transformer shall be less than 3% at peak KVA requirement during coil pickup.

MCB & fuse shall be provided for primary side of control transformers. MCB of suitable rating shall be provided on the secondary side.

Voltmeter class 1.5 and scale 0-250 V.

Control transformer shall be horizontally mounted in one of the bottom compartments with adequate ventilation.

The transformer shall be double wound, dry type with class E insulating materials. The control supply for the motor feeders shall be fed through suitable rated MCBs.

Control transformers shall be provided with +/- 5% and +/-10% voltage taps on 415 V side.

The control bus of the PDB shall be electrolytic grade aluminium/copper only and will be designed to carry the transformer rated secondary current as well as withstand the available short circuit level.

Control buses of two sections shall be connected through sectionalising switch. Indication lamps shall be connected to 240V AC supply.

Isolation arrangement shall be provided on each panel to facilitate fault location and testing. Separate fuses shall be provided for spring charging motors, for indication lamps and for closing/tripping circuits of each cubicle.

3.4 Inscriptions

Identification labels shall be provided for each PDB as well as for each compartment, control device and other components.

PDB designation at the top of central panel with letters of 25 mm (min.) height.

Anodised Al. Plates (Black background and white lettering) for each feeder inscriptions with letters of mm. 6 mm height for each module on door.

Each component shall be identified as per schematics by good quality polyester film stickers on components and by painting in a conspicuous place on the panel body.

Terminal blocks shall be identified as per schematics with stickers / stenciling by black paint.

Danger boards as per IS on front & rear end of PDB in English, Hindi & local language.

3.5 Earthing

A continuous earth bus shall be provided for the PDB at the bottom with an earthing bolt at each end. Bolted joints with tooth spring washers shall be provided for good earth continuity.

Provision shall be made for connecting 4th core incoming and outgoing cables.

The earth bus shall be of aluminium having the same size as that of neutral bus bar at the top.

Neutral and earth busbars shall be connected through a link.

Electrical equipment shall be interconnected with earth grid using minimum size 50 x 6 GI strip or



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

equivalent.

Earthing shall confirm IS: 3043 - 1987, IE rules and statutory regulations.

Internal earthing network shall be connected at two places minimum to the external- earthing network.

5.0 Feeder Types

The PDB'S shall be generally used to feed all items such as Sockets /starters / MCBs/ Other PDB_ supply panels / mobile sockets / non-UPS supply etc.

The following types of feeders shall be envisaged in PDB.

Type 'A' Incomers

- Draw out design
- Air circuit breaker of 800 / 1200 A / 1600 A rating with Microprocessor based trip release for O/L, S/C& E/F.
 - Incomer from transformer or incomers from DG set can be switched on one at a time.
- 415V, 3 Ph, 250/400/630 Amps, rated Moulded case circuit breaker with Microprocessor based trip release for O/L, S/C& E/Fwith AC3 duty contactor.
 - Current transformers to read phase currents as per PDB rating.
 - Relay as per SLD
 - Voltmeter with 3-position selector switch
 - Digital Ammeters
 - Phase (R, Y, B) Indication lamps with fuses.
 - ON/OFF/Trip indication lamps (LED type).
 - Current transformers for protection and measurement

Type 'B' Control Section

- Dry type control transformer, 415 / 240V with + 2.5 and + 5% tappings on primary, of required rating (minimum 2.5 kVA).
 - MCB on primary side and secondary side of transformer.
 - Control supply healthy (lamp) indication.

Type 'C' (Power supply Feeder module)

- Heavy duty fuse switch unit of AC 23 duty or MCCB as per SLD.
- Mechanical ON/OFF indication
- Door interlock ,defeat interlock and padlocking facility.
- Rating 32/63/100/125/250/400 A as specified / as per SLD.


Type 'D' (Spare Feeders)

- Each PMCC shall be provided with atleast 20% spare feeders or minimum of 1 no. of spare feeder of each rating whichever is maximum.

Type 'F' (Capacitor Feeders)

- Heavy duty fuse switch unit of AC 23 duty
- Mechanical ON/OFF indication
- Door interlock, defeat interlock and padlocking facility.
- Rating 32/63/125/250 A as specified / as per SLD.
- APFC relay for PF correction.
- Capacitor Bank as per SLD
- PF meter with lagging and leading indication

6.0 Special tools

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

A set of special tools required for the normal operation and maintenance shall be supplied with each PDB. The tenderer shall include, along with each PMCC, one height adjustable circuit breaker trolley for removal and replacement of the withdrawable circuit breaker carriage.

7.0 Painting

All sheet metal work shall undergo a process of

- o Degreasing
- o Pickling in acid
- o Cold rinsing & Phosphating
- o Two primer coats of Epoxy based primer suitable for corrosive (seashore) atmosphere.
- o Two finish coats of painting of light grey or approved colour shade and quality.
- o The interior of panel shall have eggshell white paint.

8.0 Inspection & testing

The owner or his authorized representatives may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.

The contractor shall submit Quality Assurance Plan (QAP) for respective equipments within three weeks of award of contract. Owner's representative shall be given minimum two weeks advance notice for witnessing the final testing.

Inspection and testing of equipment shall be carried out by the owner/ consultant at the works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approved drawings and reference national/ international standards. QAP shall be prepared and furnished by the contractor in PMC Form No.11.20 (4.4) F- 10. Test certificates including test records and performance data etc. shall be furnished by the vendor.


Inspection will be carried out on the basis of the purchaser's drawings/ manufacturer's approved drawings and instructions contained in the QAP.

QAP shall generally cover the following tests:

- Visual
- Dimensional
- Fitment & alignment
- Measurement of IR Value – Before HV test & after HV test
- High voltage test/ dielectric test
- Routine test as per relevant IS/other standard
- Type test as per relevant IS/other standard
- Test certificates of bought out items
- Paint shade verification
- Operational & functional check
- Verification of BOM

Tests at works and tests at site shall include the following:

- a. One minute PF withstand voltage between phases, phase to earth and between open poles as well as for the auxiliary/control circuit.
- b. Insulation resistance test for power, auxiliary and control circuits.
- c. Milli volts drop across incoming and outgoing jumper connections with breaker closed and in service position.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- d. Physical inspection
- e. Operational tests
- f. Temperature rise test on main and vertical busbars
- g. Tests to prove inter changeability of breakers with same current rating.
- h. Calibration of meters (if supplier is to commission the equipment, this can be done at site)
- i. Check of control circuits
- j. Test to prove operating voltage range of spring charging motor, closing coil, trip coil and relays.
- k. Heat run test

10.0 Drawings

The following drawings shall be submitted for approval as per agreed schedule.

- a) Dimensional GA drawing of PDB indicating busbar arrangement, foundation details, gland plate location, Front view of PDB indicating component locations.
- b) Single line schematic diagram indicating feeder details.
- c) Control schemes of feeders.
- d) Component specification details.
- e) List of inscriptions.
- f) Internal wiring diagrams
- g) Terminal plan and external connection diagrams.
- h) Cross sectional drawings of cubicle indicating details of busbar chamber, cable chamber, breaker chamber etc.
- i) Catalogues of relays, breakers.
- j) Operation and Maintenance Manual
 - Recommended procedure for routine maintenance
 - Tests for checking of proper functioning
 - Diagnostic trouble shooting/ fault location charts
- k) Storage, conservation and re-commissioning Manual
- l) Safety Manual
- m) List of special tools and tackles

11.0 PACKING

The equipment shall be properly packed. Special notations such as fragile, this side up, centre of gravity, etc. shall be clearly marked on the package.

12.0 COMPLETENESS OF EQUIPMENT

All fittings, accessories or apparatus which may not have been specially mentioned in this specification but which are otherwise necessary for satisfactory working of PDB shall be deemed to have been included in the scope of supply.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
LIGHTING FIXTURES OF HAZARDOUS AREAS**

SPECIFICATION NO. -




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

C O N T E N T S

SL.NO.	DESCRIPTION
1.0	SCOPE
2.0	CODES & STANDARD
3.0	ENVIROMENTAL CONDITION
4.0	DESIGN REQUIREMENT
5.0	GENERAL REQUIREMENTS
6.0	COMPLETENESS OF EQUIPMENTS
7.0	DRAWING AND DOCUMENTS
8.0	INSPECTION

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

1.0 SCOPE

This specification defines the design, construction, testing and supply of lighting fixtures suitable for installation in classified hazardous locations in Refineries/Petrochemical plants. Unless specified in material requisition all fixtures shall be suitable for Zone-1 & Zone-2 & Gas Groups IIA & IIB as per IS 2148.

a. **Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:**

1. **Type of Hazardous areas, its zone protection grade and gas group classification for suitability of installation of adequate flameproof light fittings.**
2. **Type of Light fittings and its quantities in line with SOR.**
3. **Conventional type HPMV Well glass luminaire/ industrial grade LED flameproof luminaire**

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 CODES & STANDARDS

2.1 The design, manufacture and performance of equipment covered by this specification shall conform to the relevant Indian / International standards and Codes. In particular, the equipment offered shall conform to the latest revision of the following standards.

IS:1913 : Electric lighting fittings, general and safety requirements for Luminaires: Tubular fluorescent lamps

IS:2148 : Specification for flameproof enclosures

IS:2206 : Flameproof electrical lighting fittings Point I & II (well glass and bulk head type, fittings using glass tubes)

IS:5572 : Classification of hazardous area for electrical installation

IS:6381 : Construction and testing of electrical apparatus with type of protection 'e'


IS:8224 : Electric lighting fitting for division 2 areas

IS:8289 : Electrical equipment with type of protection 'n'

IS:10322 : Luminaires – Part – 1 – General Requirements

Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.2 In case any contradiction between various referred standards/specification/data sheets and

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

statutory regulation etc the following order of priority shall be govern -

- i) Schedule of rates
- ii) Design Basis
- iii) Scope of work/Job specification
- iv) Data Sheet
- v) Standard specification
- vi) Codes & standard

3.0 ENVIRONMENTAL CONDITIONS

The Lighting fixtures shall be designed for continuous operation under the climatic and environmental conditions as described in the “Design Basis-Electrical/Scope of Work”.

4.0 POWER SUPPLY SYSTEM

Unless until specified in material requisition all lighting fixtures shall be suitable for 220 - 250 volts single phase neutral & 50 Hz power supply.

5.0 DESIGN REQUIREMENTS

Light fittings for use in Hazardous areas have the following characteristics. They are sealed to prevent the ingress of the liquid, gas or dust, lens for lamp, protection of a robust impact resistant material. They have a seal or machined face to ensure resistance to liquid, dust or gas, or a quenching flame path. Light fittings have different grades of protection depending on their construction and intended purpose. Some fittings are classified according to their IP Ingress Protection rating as it is designated.

When Light fittings and other electrical apparatus are to be installed in a Hazardous Area it is essential that the decision maker takes measures to reduce the likelihood of an explosion by the correct selection of the equipment to be installed in that area. As the gases and vapours liable to be present are rated according to ignition temperature, Flash point and lower explosive limit, this information must be on hand when making your light fitting selection.


All flame proof fixtures and accessories shall be tested and certified by CMRI/CCE or independent authorities of country of origin for use in specified gas group location/Hazardous area. Certification number/data and gas group/temperature classification must be indicated on the manufacturer's nameplate on each fixture. Contactor shall furnish the type test data & certificates of approval of fixture for use for hazardous location along with offer.

All lighting Fixtures shall conform to the latest revision of all relevant Indian / International Standards / IS / BS / DIN etc. and statutory requirements of Govt. of India and Indian Electricity Act and statutory requirements of Govt. of Jharkhand, Safety codes & technical rules / norms.

Lighting Fixtures shall be properly packed to avoid any damage during transit. The Luminaries under the scope of supply shall be capable of functioning normally under voltage and frequency fluctuations specified in this specification.

Replacement of damaged lighting fixtures including lamps, ballast etc. during transit shall be done immediately.

Replacement of defective lighting fixtures including lamps/ ballast etc. shall be done immediately.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Energy saving features shall be provided along with the fixtures.

6.0 GENERAL REQUIREMENT

6.1 Construction

All fixtures shall be suitable for use in outdoor open location and shall have degree of protection IP-65 or above.

The body of the lighting fixture shall be of cast aluminium alloy LM-6 and should be free from frictional sparking hazard. Complete fixture body and accessories shall be suitable to withstand corrosive atmosphere. Outer metallic surface shall be treated/ prepared and provided with two coats of epoxy paint. All screws, nuts, studs, clamps, supporting brackets, etc. shall be electro galvanized or zinc passivated.

All fixtures shall be provided with sheet steel vitreous enamelled or approved type of reflector. Glass used for fixtures shall be clean, heat & impact resistant and toughened type suitable for use under conditions involving exceptional risk of mechanical damage and shall be type 'A' as per IS 2206 or the requirements stipulated by international standards. All well glass fixtures shall be provided with steel wire protecting cage having mesh dimension not exceeding 50 mm.

The fixing parts of the enclosure which is to be opened for replacement of bulb shall be so fastened that they can only be unfastened with special tools. All fixtures shall carry a special warning inscription in English to "Isolate supply elsewhere before opening". Three sets of special tools required for maintenance of fixtures shall be supplied free of cost along with the fixtures.

The temperature rise of external surface shall not exceed the temperature specified in the standards for the gas group to which fitting shall be suitable.

All junction boxes for looping for SPN Lighting circuits using cables upto 4 mm² shall be minimum 100 mm dia in size. Junction boxes for looping of large three phase cable and multiple single phase circuits shall be of minimum 300x250x100 mm. in dimension complete with flameproof cable glands as specified in material requisition.


The top of all well glass lighting fixtures shall be identically drilled/ threaded to facilitate the installation on pole/column or ceiling as per the enclosed sketch using stud/bracket supplied by others.

6.2 FLAME PROOF FITTINGS

Flame proof type fittings will be well glass type luminaries suitable for use with HPMV 80W/ 150W/ 250W/400W (High pressure Mercury Vapour) lamp to be used in gas group IIA/IIB and Zone-1/2 with separate control gear complete with copper ballast, power factor improvement capacitor, terminal block enabling loop-in-loop out connection. Fixture and lamp shall be perfectly matched and from same manufacturer. The fittings shall be supplied complete with all mounting accessories etc. The fitting shall be heavy duty and conform to IP 65 degree of protection

The control gear box and enclosure for fittings will have certification from CMRS, Dhanbad and will be suitable for gas groups IIA & IIB as per IS 2148-1981. The fittings will be designed as per IS 2206 (Part-I) -1987. The material for cable gland will be brass/stainless steel/aluminium alloy LM6 and will be double compression type suitable for indoor/outdoor use. These are must for every flameproof fittings and accessories.

Alternatively, LED flameproof well glass luminaire of 30W/ 40W (in place of 70W/125W HPMV) / 60W (in place of 250W HPMV) / 90W (in place of 400W HPMV), recommended for illuminating

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

hazardous area laden with gases or vapors of group IIA, IIB & IIC & zone 1 & 2, suitable for industrial lighting may also be used as per manufacturer's standards. It shall have High pressure die cast aluminum housing with housing with toughened clear heat resistance well glass is cemented into a retaining ring which is fixed with screws to the main housing and the High power COB/SMD LEDs shall have luminous efficacy greater than 140 lm/W. It shall consist of highly reliable constant current LED driver. The LEDs shall withstand minimum surge protection of 4KV. The fitting shall be heavy duty and conform to IP 66 degree of protection.

7.0 COMPLETENESS OF EQUIPMENT

All fittings, accessories or apparatus which may not have been specially mentioned in this specification but which are otherwise necessary for satisfactory working of installation & working of lighting fixtures shall be deemed to have been included in the scope of supply.

8.0 DRAWINGS & DOCUMENTS

Documents to be submitted along with the bid/offer:

- Confirmation of scope of supply. All pages of NIT to be signed.
- Un-priced copy to be submitted stating "quoted" against each item.
- Latest Catalogue.

Following drawings/ documents/ data shall be submitted for approval by the tenderer:

- Lighting Fixture Data sheets.
- GA of fixtures including mounting arrangement (Ceiling / wall/ structure / Pole).
- Bill of Materials (BOM).
- Product Catalogue.

9.0 TESTING AND INSPECTION

After completion of manufacturing of Lighting Fixtures and prior to despatch, the Lighting Fixtures shall be subjected to type, routine, acceptance and special tests as per the approved QAP. Purchaser / Consultant reserve the right to witness all tests with sufficient advance notice from vendor.

Inspection call shall be given by the manufacturer for association of purchaser or his representative during inspection. Inspection call shall be given minimum 15 days in advance from the proposed date of inspection. Four sets of relevant manufacturer test certificates, test certificate for major bought out components, internal inspection report of tenderer (if applicable) etc. as per the approved QAP shall be enclosed with each inspection call.

Inspection and testing of equipment shall be carried out by the owner/ consultant at the works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approval draws. and reference national/ international standards.


The contractor shall submit Quality Assurance Plan (QAP) for respective equipments within 3 weeks of award of contract.

QAP shall be prepared and furnished by the contractor in PMC Form No. 11.20(4.4) F-10 along with their internal in process quality checks.

Routine test and type test certificate shall be furnished for review.

The following type tests shall be carried out as per applicable Indian Standards and shall form part of acceptance testing

- a) Dimensional check up

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- b) Static hydraulic test
- c) Impact test
- d) Thermal shock test
- e) Durability test
- f) Test for temperature rise
- g) Test for flameproofness

Acceptance test shall be witnessed by owner/consultant.

The following tests shall constitute acceptance tests:

- a) Dimensional check up
- b) Static hydraulic test
- c) Impact test
- d) Thermal shock test
- e) Durability test

The following tests shall constitute routine tests:

- a) Dimensional check up
- b) Static hydraulic test

10.0 PACKING / PROTECTIVE SHIPPING & DELIVERY:

10.1 Packing And Forwarding:

All items shall be covered with water proof plastic packages and then packed in wooden crates. Dehumidifying agents shall be put inside the packing. All heavy items like control panels, etc. shall be properly supported by wooden structures before dispatch to avoid any damage during transit and handling of the packages. Electrical equipment shall be delivered to the consignee site by road transport Lorry receipt, invoices, packing list, etc. shall be sent to the consignee along with dispatch of equipment.

10.2 Match Marking:

The sub-assemblies/parts shall be properly match marked before dismantling for packing and dispatch. Manufacturer for reference during erection at site shall submit match-marking drawings to the purchaser.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
CAPACITOR BANK**

SPECIFICATION NO.-



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

C O N T E N T S

SL. NO. DESCRIPTION

INTENT

- | | |
|-----|------------------------------|
| 2.0 | CODES & STANDARDS |
| 3.0 | TECHNICAL REQUIREMENTS |
| 4.0 | DRAWINGS AND DOCUMENTS |
| 5.0 | INSPECTION & TESTING |
| 6.0 | CAPACITOR SIZING CALCULATION |



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 INTENT

- a) The intent of this standard specification is to define the general requirements for design, manufacture, assembly and testing at manufacturer's works, packing, transportation and receipt at site with all materials and accessories of Capacitor Bank.
- b) Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:
1. Requirement of Capacitor bank and its rating & voltage level.
 2. Number of Steps/Switching Conditions/ Capacitor Units and its corresponding ratings.
 3. Incoming feeder rating/ switchgear details etc. or other project specific details, if any.

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 CODES & STANDARDS

The Capacitor bank shall comply with the latest edition of the following and other relevant Indian standards. In case equipment is supplied by foreign manufacturers relevant international standards shall be applicable.

- IS: 2834:1986 - Specification for Shunt Capacitors for power systems.
IS – 13340: 2012 - Specification for Shunt Power Capacitors of Self- healing type for AC Systems upto rated voltage of 1100V
IS: -13925:2012- Specification of Shunt Capacitors for AC power systems for Voltages above 1000V

IEEE - Recommended practice for electrical power distribution (Std. 141) for industrial plants.

3.0 TECHNICAL FEATURES

AUTOMATIC POWER FACTOR CORRECTION EQUIPMENT

The capacitor banks rating shall be selected in such a way so that the power factor shall be maintained to 0.95 or higher at 415 V at all load conditions.

The actual rating of the capacitor bank shall be finalised during drawing approval stage and it shall be provided without any price variation. The rating of the capacitor feeding cables shall be 30% higher than the normal rating

The capacitor bank shall be sheet steel enclosed, free standing, dust & vermin proof and suitable for indoor service. The banks shall be complete with capacitors, busbars chamber and busbars, suitable discharge resistor and fuse for individual capacitor, arrangement for cable entry and termination, earthing terminal, nameplate etc.

The control panel shall be complete with all relays, contactors, switches, lamps etc. Both manual and automatic correction shall be provided. The panel shall be sheet steel enclosed, free standing, dust & vermin proof and suitable for indoor service. The panel shall be complete with busbars chamber and busbars and arrangement for cable entry and termination, earthing terminal, nameplate etc.

The minimum voltage rating of capacitors shall be 460V (phase to phase). CFS unit and contactors shall



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

be suitable for capacitor switching duty. Capacitor shall have higher voltage rating to account for series reactor and 10% system over voltage.

LT capacitors shall be controlled by contactors. The total bank isolation, from the MCC bus, shall be achieved by suitably rated CFS unit having capacitor switching capability. Current rating of CFS unit shall be 30% higher than the normal rating of capacitor bank.

Capacitor bank shall have generally use of different capacity ratings such as of 12.5KVAR , 25KVAR , 50 KVAR , 100 KVAR and so on , that shall be used such that control of desired power factor by proper selection of capacitor rating switching requirements can be more accurately achieved.

Each capacitor bank shall be of 3 Nos. of each individual capacitor rating units connected in delta & should have external fuses for protection. Each capacitor feeder shall have under voltage and over voltage protection by using relay.

Each capacitor shall have series reactor/ choke inductance to control the inrush current. The tenderer shall furnish the rating of capacitor bank and the series reactor/ choke inductance along with calculations in the offer based on data indicated in SLD.

Necessary CT requirement for automatic power factor correction in the incomer breaker panel shall be provided for automatic intelligent power factor controller. Automatic measurement system of the running load / power factor shall be provided to calculate the desired capacitor bank loading through use of automatic correction / capacitor bank switching command.

3.1 Capacitor units

Each capacitor unit shall be fully enclosed in sheet steel on plastic container of adequate thickness suitable for mounting inside the capacitor cubicle. The unit shall be supplied with necessary accessories for forming bank of specified rating.

Capacitors shall be of polypropylene dielectric with self-healing properties. Each unit shall have built-in discharge resistor, series reactor and unit protection fuses and two terminal bushings. The fuses shall not deteriorate or operate due to repeated switching at rated voltage.

The minimum voltage rating of capacitors shall be 440V (phase to phase). Capacitor shall have higher voltage rating to account for series reactor and 10% system over voltage.

The unit shall conform to IS-2834-1981 / IS-13925 and shall be suitable for an ambient of 50 degrees C.

PARAMETER	SPECIFICATION
Rated voltage -	460V AC
Rated frequency -	50 Hz
Max. over-current -	1.3 times rated current
Max. over-voltage -	1.1 times rated voltage
Max. over load	
Fuse (capacitor unit) -	1.3 times rated output
-External fuse connected before capacitor	
Mounting -	IP54 enclosure mounted in a panel / box
Discharge device -	Directly connected discharge device across the capacitor (in the same enclosure) to limit the residual voltage
Connection -	By PVC copper / Aluminium cable suitable for bottom entry
Earth connection -	Distinct earth terminals clearly marked . Specify terminal size
Bank connection -	Delta connected
Max. permissible withstand capacity -	As per IS13340
Peak inrush current -	As per IS13340
Over voltage / long duration voltage withstand capacity -	As per IS13340
Temperature class -	Suitable for 45 deg C ambient (as per IS 2834). - Specify class selected.
Capacitance tolerance -	PI specify
Terminals -	Specify size with cable gland details



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Bushing type - PI specify
Insulation level - 2.5 KV

3.2 Capacitor banks

Each LT switchboard section shall have specified number and rating of capacitor banks. The capacitor banks shall be delta connected using singlephase units rated for 440 V. Where capacitor banks of different ratings are specified, the same shall be built-up from a single standard capacitor unit. The capacitor bank formation inside the cubicle shall be formed considering easy accessibility for each unit and better air clearances. All bus work shall be adequately supported for maximum fault level specified.

Each bank shall be independently controlled. All the banks shall be controlled automatically based on bus power factor. The control scheme shall be such that maximum number of steps are achieved for smooth control of power factor.

3.3 Control equipment

Each capacitor bank shall have independent control equipment comprising fuse switch unit, power contactor with auxiliary contacts, line CTs with taut band ammeter and selector switch to read phase currents of capacitor bank feeder, ON/OFF indicating lamps, auto/manual selector switch, auxiliary relays and any other equipment required for satisfactory operation, maintenance and control. Local/remote selector switches where specified shall be provided for switching ON/OFF capacitor banks from remote location. Each bus section shall have a multistage (12 stage) microprocessor based PF relay with associated contactors, bus PF meter for group control of the banks connected to respective bus section. The power factor controller shall have LCD display with indication of inductive/capacitive power factor, active outputs, demand for switching on/off of a capacitor step, alarm conditions, overtemperature conditions, phase shift, C/K ratio, type of switching sequence etc. It shall also have optional RS-485 Modbus adaptor for allowing communication with a monitoring system.

All switching equipment shall have capacitor switching rating of 150% of rated current of capacitor bank. All equipment shall be suitable for 240 V AC control supply. Necessary protection through HRC fuses shall be provided for control circuits. Control supply shall be drawn preferably through control transformer. Necessary interlock shall be provided to ensure switching-on of capacitor banks after it is fully discharged.

3.4 Details to be furnished in datasheet of APFC Panel:

- i) Name of manufacturer
- ii) kVAR rating
- iii) Rated voltage
- iv) Rated Frequency
- v) Number of phases
- vi) Type of connection
- vii) Enclosure details
- viii) Material of construction and its thickness
- ix) Dimensions
- x) IP Protection class
- xi) Application
- xii) Cable entry details
- xiii) Paint shade
- xiv) Busbar details – Material, cross section, busbar supports etc.
- xv) Capacitor type
- xvi) Number of steps
- xvii) Configuration details
- xviii) Switchgear details – Incomers, outgoing, APFC Relays etc.
- xix) Bill of material



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

4.0 DRAWINGS AND DOCUMENTS

4.1 Vendor shall furnish all data/drawings/documents specified in the vendor data requirement. Approval of the drawing shall not relieve the manufacturer of his responsibility to equipment conforming to the relevant specification and standards or for any mistakes, errors or omissions in the drawing.

4.2 Following Drawings & Documents shall be submitted after award of contract for approval:

- i) List of drawings
 - a) Overall General arrangement drawing
 - b) Capacitor bank details
 - c) Capacitor sizing calculation
 - d) Technical Datasheet
 - e) Bill of material
 - f) QAP, Internal Test Certificates and Inspection Certificates
- ii) Instruction manuals for erection, testing and commissioning.
 - a) Instruction manual shall give step by step procedure for:
 - Erection, testing and commissioning
 - Operation
 - Maintenance and
 - Repair
- b) Operation and Maintenance Manual
 - Recommended procedure for routine maintenance
 - Tests for checking of proper functioning
- iii) List of special tools and tackles

5.0 TESTS AND ACCEPTANCE

Tests shall be carried out at manufacturer's works under his care and expense.

The manufacturer shall submit a QAP inline with the format enclosed for approval of PMC. All tests and documents of inspection documents shall be done based on this.

All routine tests as specified by the applicable standard code shall be conducted. Type test certificates for the Capacitor bank from a recognized testing organization shall be furnished with the bids. The vendor shall also submit a list of guaranteed technical particulars with the bids.


In addition, specific tests shall be conducted to check mechanical and electrical operation/wiring etc. and panel wiring conforming to the specification and approved schematic drawings.

All routine tests on capacitor banks shall be conducted as per relevant standards (Refer IS: 13118 – latest revision).

Above tests shall be provisionally conducted at manufacturer's works by providing temporary connection to switchgear units in order to simulate the actual conditions.

QAP shall generally cover the following tests:

- Visual
- Dimensional
- Fitment & alignment
- Measurement of IR Value – Before HV test & after HV test
- High voltage test/ dielectric test
- Routine test as per relevant IS/other standard
- Type test as per relevant IS/other standard
- Impulse test HT
- Test certificates of bought out items

	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
-----------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

- Paint shade verification
- Operational & functional check
- Verification of BOM

Type tests:

- Thermal stability test
- Measurement of the tangent of the loss angle (tan δ) of the capacitor at elevated temperature
- Voltage test between terminals
- Voltage test between terminals and container
- Lightning impulse voltage test between terminals and container
- Discharge test
- Ageing test
- Self-healing test
- Destruction test

Routine tests:

- Capacitance measurement and output calculation
- Measurement of the tangent of the loss angle (tan δ) of the capacitor at elevated temperature
- Voltage test between terminals
- Voltage test between terminals and container
- Test of the internal discharge device
- Self-healing test

All the capacitor banks shall be subjected to the routine tests as per IS 13340 at manufacturer's works. Type test certificates for similar design have to be submitted for approval. Test procedures as specified in IS-13340 shall be adopted.

6.0 CAPACITOR SIZING CALCULATION (To be submitted by the vendor)

- i) Required kVAr = kW [tan cos-1(initial pf) – tan cos-1(final pf)]
- ii) kVAr of capacitor bank = $\frac{2 \times \pi \times f \times C}{100}$
- iii) kVAr of series reactor = kVAr of capacitor bank x % of reactor
- iv) Current of series reactor = $\frac{\text{kVAr of capacitor bank}}{\text{kV} \times \sqrt{3}}$
- v) Inrush current = $\frac{U \sqrt{2}}{\sqrt{XC \times XL}}$

CABLE INSTALLATION

General

Cable installation shall include power, control and lighting cables. These shall be laid in trenches/cable trays as detailed in the power layout drawings. Cable routing given on the power layout drawings shall be checked in the field so as to avoid interference with other services such piping, instrumentation, civil, structural, mechanical etc. Any change in routing shall be done to suit the field conditions suitably interfacing with other services wherever deemed necessary, after obtaining approval of Purchaser.

High voltage, medium voltage power and control cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cables trays, as shown on power layout drawings/installation



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

details. Details of cable routes and cable spacings not shown in detail drawing shall be determined by the Contractor and approved by the Purchaser.

High voltage, medium voltage power and control cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cable trays, as shown on layout drawings/installation standards. Details of cable routes and cable spacings not shown in detail on these drawing shall be determined by the Contractor and approved by the Purchaser.

When single core cables are laid in flat formation, the individual cable fixing clamps and spacers shall be of non-magnetic material. As a general practice, the sheath of single core cables shall be earthed at one point to keep sheath at earth potential unless otherwise stated. Single core cables, when laid in trefoil formation shall be braced by suitable clamps at a distance, not exceeding 3 meters along the cable routing.

If straight through joints are required to be provided on single core cables, armour shall be broken at joints as per Supplier's recommendations. For single core cables, armour shall be earthed at one end for the cable run length as per Supplier's recommendation.

Minimum spacing of 300 mm between power, control cables and Telephone, Communication, Fire alarm cables shall be maintained.

The lengths indicated in the cables schedule are only approximate. The Contractor shall ascertain the exact length of cable for a particular feeder by measuring at site. All cable routes shall be carefully measured. Before the start of cable laying, the Contractor shall prepare cable drum schedule and get that approved by Purchaser to minimize/avoid.

straight though joints and then the cables cut to the required lengths, leaving sufficient lengths for the terminations of the cable at both ends. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. Extra loop length shall be given for feeder cables where required as per the directions of Purchaser to meet contingencies.

Cables shall be laid in directly buried trench or in RCC trench (underground trench) or in cable tray along pipe sleepers or in over head trays as shown on power layout drawings.

Overhead trays shall be installed 2700 mm (minimum) above grade level. At road crossings overhead trays shall be installed at 7000 mm (minimum) above level or cables shall be routed cable tray culvert/Electrical road crossings as per power layout drawings.

Sufficient care shall be taken while laying cables to avoid formation of twist, sharp bend etc. in order to avoid mechanical injuries to cables. Rollers shall be used for pulling of cables Cable installation shall provide minimum cable bending radii as recommended by cable Supplier.

Cables shall be neatly arranged in the trenches/trays in such a manner that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be in line with power layout drawings. Cable routing between cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45 to the trench wall. Bending radii of pipes shall not be less than 8D. It is to be ensured that both the ends of GI pipe sleeves shall be sealed with approved whether proof sealing plastic compound after cabling. In places where it is not possible, cables shall be laid in smaller branch trenches.

All cables shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tag numbers shall be punched on aluminium straps (2mm thick, 20 mm wide and of enough length) securely fastened to the cable and wrapped around it.

Each underground cable shall be provided with cable tags of lead securely fastened every 30 m of its underground length with at least one tag at each end before the cable enters/leaves the ground. In unpaved areas, cable trenches shall be identified by means of cable markers as per installation drawing. These cable markers shall be placed at location of changes in the direction of cables and at intervals of not more than 20 m and also at cable straight through joint locations.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of cables shall be taped with an approved PVC end cap or rubber insulating tape.

Each row of cables shall be laid in place and before covering with sand. All wall opening/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building /lined trench. Every cable shall be given an insulation test in presence of Purchaser before filling the cable trench with sand. Any cable which is found defective shall be replaced.

Where cables pass through foundation walls, the necessary openings shall be provided in advance for the same by another agency. However, should it become necessary to cut holes in existing structures for example floor slab etc., the Contractor shall determine their location and obtain approval of the Purchaser before carrying out the same.

Cables for road crossings shall be taken through ERC (Electrical Road Crossing) as shown in the power layout drawings.

At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.

Wherever cable trench crosses storm water, waste water channel/drain, cables shall be taken through PVC/RCC pipes. Where cables are required to cross drains of depth more than 1200 mm, cables shall be taken over the drain on cable trays supported suitably using ISMC 150/200 sections.

Ends of cables leaving trench shall be coiled & capped and provided with protective cover till such time the final termination to the equipment is completed.

Cables laid direct in ground

Cables shall be laid underground in excavated cable trenches where specified in cable layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables. Cables shall be properly spaced and arranged with a view of heat dissipation and economy of design. Maximum number of cable layers in trench shall be preferably limited to 5 layers.

Minimum depth of cable trench shall be 750 mm for medium voltage and 900 mm for H.V. Cables. The depth and the width of the trench shall vary depending upon the number of layers of cables

Cables shall be laid in buried trenches at depth as shown in the power layout drawings. It is to be insured by the Contractor that the bottom of buried trenches shall be cleared of all rocks, stones and sharp objects before cables are placed. The trench bottom shall be filled with a layer of sand. This sand shall be levelled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the largest diameter cable and sand shall be lightly compacted. A flat protective covering of 75mm thick second class red bricks shall then be laid and the remainder of the trench shall then be back – filled with soil, rammed and levelled.

Cables laid in concrete trench

Cables shall be laid in 3 or 4 tiers in concrete trench as shown on power layout drawings. Concrete

cables trenches shall be filled with sand in hazardous area to avoid accumulation of hazardous gases and oil. RCC covers of trenches shall be effectively sealed to avoid ingress of chemical and oil in process area. Removal of concrete covers where required for the purpose of cable laying and reinstating them in their proper position after cables are laid shall be done by Contractor.

All wall opening /pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water.

Above ground cables

a) Cables installed above grade shall be run in cable trays, clamped on walls, ceiling or structures and shall be run parallel or at right angles to beams, walls or columns. Cable routing shall be planned to be away from heat sources such as hot piping, gas, water, oil drainage piping, air- conditioning duct etc. Each cable tray shall



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

contain only one layer of cables as far as possible for power cables. However control cables may be laid in double layer in the cable trays.

b) Individual cable or small group of cables (upto 3 to 4 cables) which run along structures/walls etc. shall be clamped by means of 16 SWG GI saddles on 25 x 6 mm saddle bars. Alternatively small group of cables can be taken through 100/150 mm slotted channel tray/ISMC 100.

Cables shall be supported so as to prevent sagging. In general, distance between supports shall be approximately 300 mm for cables upto 25 diameters and maximum 450 mm for cables larger than 25 mm dia. To prevent the sagging of cables.

c) Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. saddles/clams, whereas cables in horizontal run of cable trays shall be tied by means of nylon cords. Distance between supporting angles shall not exceed 600 mm.

d) All cable trays (other than galvanized trays) and supporting steel structures shall be painted before laying of cables. The under surfaces shall be properly degreased, derusted, descaled and cleaned. The painting shall be done with one coat of redoxide zinc chromate primer. Final painting shall be done with two coats of approved bituminous aluminum paint unless otherwise specified.

e) Where cables rise from trench to motor, lighting panel, control station, junction box etc., they shall be taken in GI pipe for mechanical protection upto a minimum of 300 mm above grade. Cable ends shall be carefully pulled through conduit to prevent damage to cable.

All G.I. Pipes shall be laid as per layout drawings and site conditions. Before fabrication of various profiles of pipes by hydraulically operated bending machine (which is to be arranged by the Contractor) all the burrs from the pipes shall be removed. GI Pipes having bends shall be buried in soil/concrete in such a way that the bend shall be totally concealed. For G.I. pipes buried in soil, bitumen coating shall be applied on the buried lengths. Installation of G.I. pipes shall be undertaken well before paving is completed and necessary co ordination with paving agency shall be the responsibility of Contractor.

Following guide shall be used for sizing of G.I. pipe.

- i) 1 cable in a pipe - 53 % of pipe cross-sectional area occupied by cables.
- ii) 2 cables in a pipe - 31 % of pipe cross-sectional area occupied by cables.
- iii) 3 cables in a pipe - 43 % of pipe cross-sectional area occupied by cables.
- iv) 4 and above cables in a pipe - 40 % of pipe cross-sectional area occupied by cables.

After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound / bitumen / suitable sealing compound. Alternatively rubber bushes shall be employed for the purpose of sealing

Terminations

a) All HV and MV cables shall be terminated at the equipment by means of single/double compression type cables glands as specified suitable for the cable size. They shall have a screwed nipple with conduit electrical threads and check nut. The cables shall be identified close to their termination points at both the ends of cable (cable numbers shall be punched on aluminium strips 2mm thick and securely fastened to the cables wrapped around it) and also along the route at recommended intervals, by cable tag numbers.

All cable entries for outdoor termination shall be preferably through bottom. Outdoor cable termination through top of equipment shall not be permitted.

b) Power cables cores wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminum connections are made, necessary bimetallic washers shall be used.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

c) In case of control cables, all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules suitable for core size. Wire numbers shall be as per schematic/wiring/inter-connection diagram. All unused spare cores of control, cables shall be neatly bunched and ferruled with cable tag at both ends, for future use.

For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/Control panels and Control Switches.

d) Contractor shall drill holes for fixing glands wherever necessary. Gland plate shall be of non-magnetic material/aluminium sheet in case of single core cables. All unused cable entries on equipment/panels shall be plugged/sealed.

e) The cable shall be terminated at electrical equipment /switchboards through glands of proper size. The individual cores shall then be dressed and taken along the cables ways or shall be fixed to the panels with polyethylene straps. The cable glanding shall be done as per Supplier's instructions. Cable armour shall not be exposed after termination is complete. In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit holes shall be drilled in the gland plate for all the cables in one line, and then gland plate shall be split in two parts along

the centre line of holes. After fixing bottom plate, uncovered cable holes/gaps shall be sealed with cold setting compound.

f) Crimping of lugs to cable leads shall be done by hand crimping/hydraulically operated tool as per requirement. Insulation of the leads shall be removed before crimping. Conductor surface shall be cleaned and shall not be left open. Suitable conducting jelly shall be applied on the conductor lead. Lugs shall enclose all strands of cable core. Cutting of stands shall not be allowed.

g) HV cables shall be terminated with heat shrinkable termination kits, indoor or outdoor type as specified by approved HV cable jointers. Supplier's instructions shall be followed for applying heat shrinkable termination kits.

h) The Contractor shall bring to the notice of Purchaser any mismatch in cable glands, lugs provided with the equipment vis-à-vis to the cable size indicated in cable schedule for taking corrective action.

i) The cable joints in power and control cables shall be avoided as far as possible. In case a joint is unavoidable, the following shall be insured:

- i) The number of joints shall be restricted to minimum as far as possible.
- ii) The location of joints shall be identified with permanent markers.
- iii) No joints shall be allowed in hazardous areas without the approval of Purchaser.
- iv) No joints will be allowed in the Cable seller.

The jointing and termination of medium voltage power cables shall be carried out by trained personnel only. Jointing and termination of high voltage cables shall be done by skilled and experienced jointer duly approved by Purchaser. Only type tested termination kits of approved make shall be used.

j) No unauthorized repairs, modifications shall be carried out on the hazardous area equipment terminal boxes and junction boxes. Damaged enclosures of hazardous area equipment shall be brought to the notice of Purchaser by Contractor. After termination is complete, all the bolts, nuts, hardware of terminal box shall be properly placed in its position and tightened.

k) Where required, cable sealing boxes intended to be used with the apparatus shall be filled with solid setting type bituminous compound unless otherwise specified.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

LIGHTING INSTALLATION

General

The lighting fixtures in the plant shall be fed from lighting and small power distribution board. All outdoor lighting shall be group controlled manually or through photoelectric synchronous timer. Lighting wiring between distribution boards and lighting fixtures shall be done with 3-core (phase, neutral and earth) Cu/XLPE/SWA/PVC cable for plant areas and substation building. Wiring in the other building shall be done by means of 3-core Cu/PVC cables, or PVC insulated copper conductor wires in conduit/Metsec channel as specified. All joints of conductors in Switch boards/JBs Fittings shall be made only by means of approved mechanical connectors (nylon/PVC connectors). Bare twisted joints shall not be permitted any where in the wiring system.

The lighting and small power layouts furnished by Purchaser will indicate approximate locations of lighting fixtures. The Contractor shall determine, with approval of Purchaser, the exact locations of each fixture in order to avoid interference with other services such as piping, instrumentation, civil, structural, mechanical etc and also with a view to obtain as much uniform illumination as practicable, and to avoid objectionable shadows. Conduits shall be laid out by the Contractor to suit field conditions suitably interfacing with other services and as per directions of the Purchaser.

On walkways, platforms and other outdoor area, lighting fixtures shall be located nearer to landing of stairs or ladders, gauges, flowmeters, panel boards and other equipment to provide proper illumination.

The minimum height of any lighting fixture shall be preferably not less than 2.5 meters above the floor level.

All outdoor cable terminations to outdoor junction boxes, panels, socket outlets etc. shall be through bottom or from side. Top entries for cables shall be avoided to avoid water entry. All cable glands for outdoor terminations shall be double compression type and the gland shall be covered with PVC or rubber boot shroud. All unused cable entries shall be plugged with suitable blanking plugs.


Mounting height of equipment shall be as under :-

Top of Switch Box	: 1200 mm from FFL (Finished floor level) Bottom of
Lighting/Power Panel	: 1500mm from FFL
5/15 Amp. Receptacle	: 300mm from FFL unless otherwise specified (1200 mm for process areas and industrial sheds)
Lighting fixture	: As indicated in layout drawing
Exhaust fan	: In the cutout provided / as indicated in Layout drawings.

Fixtures shall be firmly supported from the structures. Support clamps etc. may be bolted or welded to the existing steel work or metal inserts. In case of concrete structures, where metal inserts are not available, fixtures shall be suspended from concrete surfaces with the help of anchor fasteners. In such cases special care shall be taken to see that anchoring is firm. In places where ceiling fans are provided, lighting fixtures shall be suspended below the level of fan to avoid shadow effect.

Circuit cables in a group shall be cleated to structure by using galvanised strip clamps or cable run in cable trays wherever trays are available. Spacers and cleats shall be of required size to accommodate the cables. All hardware shall be galvanised. Underground lighting cables (in paved areas) shall be taken in suitable G.I. sleeves buried at a minimum depth of 300 mm from FFL. GI pipe sleeves shall be extended to 300 mm above FFL. Exact termination/layout of G.I. pipes (for protection of cables) shall be decided at site as per site convenience in consultation with Purchaser.

Wiring for all outlet sockets shall be done with 3 cores of equal sizes for phase, neutral and earth.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

The terminals of switch sockets shall be suitable to receive the size of wire specified.

All lighting fixtures shall be provided with terminal block with required terminals suitable for connection of wire up to 2.5 sq. mm copper conductor.

The cable shall be straightened after unwinding it from the drum. All cables be clamped/laid in straight run without any sag and kink.

For location where fan points are shown, fan hooks with junction box shall be provided during concreting. Where fan hooks and J.Bs. are provided separately JB shall be located within a distance of 300mm from hook for mounting of ceiling rose.

Industrial type plug sockets with 20A switch or rating as specified shall be provided at a height of 500mm from FFL for window AC units. Socket outlets and plugs for installation in MCC room, DG room, etc. shall be of industrial metal clad type.

Wiring for exhaust fans shall be terminated in receptacles as specified in layout drawing and the connection from receptacle to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires. Switch for exhaust fan shall be located in a separate switch board along with other switches

Conduit System

Surface or concealed conduit system of wiring shall be adopted, as specified in the drawings. Required number of pull boxes shall be used at intervals to facilitate easy drawing of wires. Separate conduit shall be run for lighting and power circuits. Further, conduits for Normal lighting/Emergency lighting/DC critical lighting shall be separate. Conduit layout shall be decided at site as per site conditions. Drop conduits for switch boards shall be decided by Contractor as per wall locations shown in Architectural drawings. All exposed run of conduits on surface, shall be vertical or horizontal.

Only threaded type conduit fittings shall be used for metallic conduit system. Pin grip type or clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed.

Conduit shall be of minimum 25mm dia. Maximum number of wires permissible in a conduit shall be seven for wire size of 2.5 sq mm.

The exposed outer surface of the conduit pipes, including all accessories forming part of the conduit system, shall be adequately protected against rusting. In all cases, bare threaded portion of conduit pipe shall not be exposed unless such bare threaded portion is treated with anti corrosive preservative or covered with approved plastic compound.

Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side. Where concealed wiring is done, junction boxes (65mm deep) shall be used so as to rest on shuttering properly. All conduit connections shall be properly screwed and Junction box covers shall be properly fitted so as to avoid entry of concrete slurry.

Where concealed wiring is to be adopted, conduits shall be laid in time before concreting of the slab. Pull wire (GI or steel) shall be provided inside conduit for the ease of wire pulling. The Contractor shall coordinate his work with other agencies involved in the civil works in such a way, that the work of the other agencies is not hampered or delayed. Vertical conduit runs shall be made in wall before plastering is done so as to avoid chasing. Where chases are made for conduit run Contractor shall fill these chases or any other openings made by them after completing the work and patch the surface. During installation, care shall be taken to see that proper covers are provided to prevent rusting of conduits. Locations of all point outlets, junction boxes shall be marked with brick powder or sand so that these are easily identified after shuttering removal. As built conduit layout drawing shall be submitted by Contractor after completion of the work.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

All junction boxes, bends and other accessories shall be of the same material as that of conduit and shall have the same protective coatings.

After erection, the entire conduit system shall be tested, for mechanical and electrical continuity and shall be permanently connected to earth by means of approved type of earthing clamps.

Hazardous Area Installation

Wiring in hazardous area shall be done by using minimum 2.5mm² copper conductor armoured cable. Circuit wiring feeding hazardous areas shall be controlled by two pole switches/MCBs (for phase as well as neutral isolation).

Correct type of lighting equipment (fixtures and JBs) with regard to hazardous protection as specified in the drawing shall be installed for the areas classified as Zone 1, Zone 2 etc.

The terminations in the junction boxes and the lighting fittings shall be done avoiding possibility of loose connections due to vibrations. After the terminations are made the cover of the junction boxes and the lighting fittings shall be closed properly with all bolts and hard wares in correct position, retaining its explosion and weather protections. In fixtures having double cable entries, both the entries shall be used for looping in and looping out connection, thus minimising the use of a separate junction box. Wherever separate control gear boxes (C.G. box) are provided looping in and looping out connections shall be through CG box, thus avoiding the use of a additional junction box. All unused cable entries shall be sealed with suitable plugs.

Circuit cables shall be firmly cleated in a group along columns/ beam/ladders/side channels/platform using 1.6mm thick GI saddles on 25x3 mm GI saddle bar at intervals of 400mm to 500mm for straight run and on either side close to bending and at both termination ends as per the directions of Purchaser. Where required, 3 or more of cables may be taken in slotted channel tray after obtaining approval of the Purchaser. Cables shall not be routed along hand rails.

Where fire proofing column/structures are encountered, all cabling shall be taken in GI pipes of required size and both ends shall be sealed, well before fire proofing is done. Similarly equipment such as lighting fixture, control gear box, lighting/ power panels, field call stations, junction boxes etc. shall be installed on suitable steel mounting frame/distance bracket, thereby avoiding direct contact with the concrete used for fire proofing.

Cable glands for terminating cable on flameproof equipment shall be of double compression FLP type. Any material/equipment specified to be supplied by Contractor for installation in hazardous areas, shall be tested by CMRI and duly approved by PESO Nagpur or DGMS Dhanbad or any other applicable statutory authority. All indigenous FLP equipment shall also have valid BIS license as required by statutory authorities.

High Mast Lighting

The high masts shall be installed on concrete foundations with the base plate bolted on to the anchor bolts. The high mast shall be painted with a coat of primer and two coats of aluminium paint, the second coat to be given just before handing over to the Purchaser. The high masts shall be numbered as per drawings. The high masts shall be connected to the plant earth grid at two points.

Exact orientation of flood lighting fixtures shall be decided at site to achieve optimum utility of these fixtures.

EARTHING INSTALLATION

This consist of main earth conductor (grid conductor) forming a closed ring network with required number of earth electrodes connected to it to provide a common earth for electrical device and metallic structures. From each earth electrode two distinct connections shall be made of the main earth conductor. The earth plates shall be used for taking multiple earth connections to two or more equipment.

The earth conductors shall be laid in ground, along cable trays / cable trench / pipe rack etc as indicated on the earthing layout drawings. The location shown on the earthing layout drawings are indicative. The exact location of earth conductors in the filed shall be determined by Contractor in consultation with the Purchaser. Earth conductors shall be located avoiding interferences with other services such as piping, instrumentation, civil,structural, mechanical etc.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Where lined cable trenches are available, the earth conductor shall be laid in the trenches and shall be firmly cleated to the sidewall of concrete trenches using GI clamps at interval of 400 mm to 500 mm and near to the termination end. The earthing conductor shall run along one of the cable trays along a cable route. The earthing conductor shall be suitably cleated and electrically bonded to all the other cable trays on the same cable route at regular interval of 25 to 30 metre. The earthing for equipment shall be tapped from the main earth conductor and not from cable tray support structure. Earth conductor when laid underground shall be at a depth of 600mm below finished grade level.

Joints and tapping in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and shall be suitably protected by giving two coats of bitumen and covering with Hessian tape. Earth strip laid above ground shall be welded across straight through joints and joints shall be suitably protected by giving two coats of bitumen to avoid oxidation and insulation film formation of the strip surface. When two earth strips are to be jointed by means of welding, lap welding with an overlapping of strip equivalent to double the width of the strip and all four sides shall be continuously welded. All joints at tappings above ground shall be means of connector/ lugs. A minimum of two bolts of adequate size shall be used for this purpose. Earthing strip joints at earth plate and equipment shall be through GI bolts, nut etc.

Installation of Earth Electrodes

Earth electrodes shall be installed as shown on earthing layout drawings and installation details. The location shown on the earthing layout drawings are indicative. The exact location of earth electrodes in the filed shall be determined by Contractor in consultation with the Purchaser, depending on the soil strata and resistivity. Earth electrodes shall be located avoiding interferences with other services such as road, building foundation, column, pipelines etc. The civil area drawings shall be referred for this. The distance between two earth electrodes shall not be less than twice the depth of electrode.

Earth electrodes shall preferably be located in a moist soil which has a fine texture, grain size and distribution. Wherever practicable the soil be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes and soil packed by watering and ramming as tight as possible.

The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.

All earth electrodes shall be tested for earth resistance by means of standard earth test meter. The tests shall take place in dry months, preferably after a protracted dry spell.

The disconnect facility shall be provided for the individual earth electrode to check its earth resistance periodically.

Location of earth electrodes shall be marked by permanent markers for easy identification. All earth Electrodes shall be serial numbered and also marked on 'As Built' drawing for future reference.

Individual earth electrodes shall be provided for each lighting arrester and flood light mast.

Earthing system provided for concrete paved area by other agency where applicable; shall be connected to the plant earthing system below ground by minimum two earth connections.

Connection

The earth system connections shall generally cover the following:

- Equipment earthing for personnel safety
- System neutral earthing
 - Static and lighting protection The following shall be earthed.
- System neutral
- Current and potential transformer secondary neutral
 - Metallic non-current carrying parts of all electrical apparatus such as transformers, switchboards, bus duct, motors, neutral earthing resistors, capacitors, UPS , battery charger panels, welding receptacles, power sockets, lighting / power panels, control stations, lighting fixtures etc.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- Steel structures/ columns, rail loadings platforms etc.
 - Cable trays and racks, lighting mast and poles.
 - Storage tanks, spheres, vessels, columns and all other process equipment.
 - Fence and gate for electrical equipment (e.g. transformer, yard etc.)
 - Cable shields and armour
 - Flexible earth provision for Wagon, Truck
 - Shield wire
- Conductor size for branch connection to various equipment shall be as per Installation details unless otherwise stated on earthing layout drawings.

All process pipelines shall be bonded and earthed at the entry and exist points of battery limit of hazardous area. Earth continuity conductors across pipe flanges shall not be provided as per OISD 110.

Steel pipe racks in the process units and offsite area shall be earthed at every 24 metres.

Equipment / street light pole etc. located remote from main network may be earthed by means of individual earth electrode and earth conductor unless otherwise stated in specifications.

The main earthing network shall be used for earthing of equipment to protect against static electricity.

All medium and high voltage equipment (above 250V) shall be earthed by two separate and distinct connections with earth.

Plant instrument system clean earthing, UPS system clean / safety earth shall be separate from the electrical earthing system.

All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.

All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground wherever provided. Equipment foundation bolts shall not be used for earthing connection.

Earth connections shall be made through compression type cable welded lugs.

All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections and all connections adequately locked against loosening.

Lighting fixtures and receptacles shall be earthed through the extra core provided in the lighting circuit/ cable for this purpose.

The reinforcement of sub-station building and the sub-station floor shall be connected to main earth grid.

LIGHTNING PROTECTION INSTALLATION

Lightning protection shall be provided for the equipment, structure and buildings as shown on lightning protection layout drawings. Self conducting structures shall not require separate aerial rod and down conductors. These shall however be connected to the earthing system at two or more points as shown on earthing layout drawing. An independent earthing network shall be provided for lightning protection and this shall be bonded at least at two points with the main earthing network below ground. Lightning down conductor shall be brought to earth electrode in shortest straight path as feasible to minimize surge impedance. Aerial and down conductors shall be located avoiding interferences with other services such as ducts, pipes, equipment, supports etc.

3.0 LIST OF CONSTRUCTION EQUIPMENT

The contractor shall have all necessary construction equipment, tools and tackles and testing instruments to carry out the erection works and to commission the system as specified. These shall include but not be limited to the following, and these shall be brought to site by contractor before the start of work.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Equipment

1. Portable grinder.
2. Portable welding machine.
3. Portable gas cutting / welding set.
4. Pipe threading machine.
5. Pipe bending machine (hydraulic).
6. Portable drill machine suitable to take up drilling for different sizes as per requirement.
7. Dewatering pump sets (diesel driven).
8. Power Hacksaw.
9. Conduit Dyset.
10. Hydraulic crimping Machine
11. Hand crimping tool.
12. Portable electric blowers, vacuum cleaners.
13. Miscellaneous items such as slings, pulleys, tarpaulins, wooden sleepers, ladders, etc. as required.
14. Safety belts, safety goggles, and gloves.
15. Separate tool kit for each Electrician. Test Instruments
 1. Insulation tester 1000V hand driven.
 2. Insulation tester 2500V motor/hand driven.
 3. Insulation tester 5000V motor/hand driven
 4. Phase sequence indicator.
 5. Earth Resistance tester.
 6. Single phase variac
 7. 3 phases variac of adequate capacity.
 8. Secondary injection testing kit (By Vendor).
 9. Multimeter both analogue and digital
 10. Portable Ammeters, Wattmeters, P.F. meters.
 11. Portable Voltmeters.
 12. Clip on meters of different ranges.
 13. Tacho-meter.
 14. Kelvins double bridge for measurement of very low resistance.
 15. D.C. high -pot test kit.
 16. Oil filtration machine of adequate capacity.
 17. LUX METER to measure illumination levels.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
HV & LV CABLES**

SPECIFICATION NO. –



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**


VOLUME II OF
II

SL NO.

CONTENTS

DISCRIPTION

1.0	SCOPE
2.0	CODES AND STANDARDS
3.0	ENVIRONMENTAL CONDITIONS
4.0	DESIGN REQUIREMENTS
5.0	CABLE SPECIFICATION
6.0	GENERAL REQUIREMENT
7.0	CABLE DRUMS
8.0	TRANSPORTATION AND UNLOADING
9.0	DRAWINGS AND DOCUMENTS
10.0	INSPECTION
11.0	TYPICAL CALCULATIONS

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

1.0 SCOPE

a. This specification is intended to detail the selection criteria of HV power & LV Power and control cables besides covering general requirements, testing at manufacturer's works, packing, transportation and receipt at site.

b. **Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:**

1. **Voltage grade, Conductor material, type of insulation and size of cables.**
2. **Schedule of quantities of cables**

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 CODES & STANDARDS

The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specifications, codes of practice of Indian Standards Institution, approved drawings and instructions of Engineer-in-Charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instruction of Engineer-in-Charge shall be binding.

The cables shall comply in design, material, testing and performance to the following codes and standards. The latest revision of the publication referred to shall apply.

- | | |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------|
| IS-1554 | : PVC insulated (heavy duty) electric cables. |
| IS-3961 | : Recommended current ratings for cables; PVC insulated and PVC sheathed heavy duty cables. |
| IS-3975 | : Mild steel wires, straps and tapes for armouring of cables. |
| IS-5831 | : PVC insulation and sheath of electric cables. |
| IS-7098 | : Cross-linked poly ethylene XLPE insulated PVC sheathed cables. |
| IS-8130 | : Conductors for insulated electric cables and flexible cords. |
| IS-10418 | : Drum for electric cables. |
| IS- 10810 | : Method of test for cables |
| IS-13573 | : Joints and terminations for polymeric cables for working voltages from 6.6 KV & including 33KV; performance requirements & type tests. |

The cables and accessories shall conform to the provisions of Indian Electricity Rules and other statutory regulations as applicable.

2.1 Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.2 In case any contradiction between various referred standards/specification/data sheets and statutory regulation etc the following order of priority shall be govern -

- i) Schedule of rates
- ii) Design Basis
- iii) Scope of work/Job specification
- iv) Data Sheet
- v) Standard specification
- vi) Codes & standard

3.0 ENVIRONMENTAL CONDITIONS

The cables shall be designed and calculated for continuous operation at full load under the climatic and environmental conditions as described in the “Design Requirements and Cable technical specifications”.

4.0 DESIGN REQUIREMENTS

The cross section of all power cables shall be determined in accordance with the current demand of the linked power consumer, the maximum permissible voltage drop, the operating temperature, thermal short-circuit capacity, maximum cable loop impedance for earth faults and laying conditions.

Cable cross-sections shall be determined using the manufacturer’s published data and the respective reduction factors according to installation conditions. The current-carrying capacities of power cables shall be calculated according to the type of operation, the conditions of installation and the ambient condition. The factors/parameters influencing cable sizing/ selection are as follows:

- Above ground or underground
- Installation / arrangement - e.g. for underground cables, is it directly buried or buried in conduit? For above ground cables, is it installed on cable tray / ladder, against a wall, in air, etc.
- Ambient or soil temperature of the installation site
- Cable bunching, i.e. the number of cables that are bunched together
- Cable spacing, i.e. whether cables are installed touching or spaced
- Soil thermal resistivity (for underground cables)
- Depth of laying (for underground cables)

Following points shall be taken into consideration during selection of cables:

- All LT power cables shall be 3.5 / 4 cores XLPE/PVC.
- Minimum size of the cables used in LT power feeders shall be 6 sq.mm for aluminium conductor and 4 sq.mm for copper conductor.
- Maximum cable size shall be 240 sq.mm for incomers to MCCs, PCCs etc.
- The minimum cable size selected for applications in the power circuits of cranes and other moving mechanisms shall be 6sq.mm with copper conductor.
- Flexible copper cables shall be used for power supply to vibrating mechanisms,
- For hoists, cranes, conveyors etc. shall be provided with flexible / festoon cable system, through butyl rubber / EPR insulated PCP/CSP sheathed flexible cables.
- Cables used for circuits of tacho generators, brakes, solenoids, field windings and secondary windings of measuring transformers shall be copper conductor with cross- sectional area not less than 2.5sq.mm.
- For control circuits, PVC insulated and PVC sheathed multicore cables with copper conductors having a minimum cross-sectional area of 2.5sq.mm shall be used. The number of cores may

be standardized as 3, 5, 7, 10, 14, 19, and 24.

- Special screened/shielded cables shall be used for mA and mV signals.
- 20% spare cores shall be provided with minimum 1 spare core in multi-core control and signal cables
- For calculating the current rating of LT power cables de-rating factor of 0.65 shall be considered.

HT Cable sizes for LT sub-station transformers

- The cable size shall be calculated based on the short circuit calculation considering breaker opening time of 0.25 seconds

Cable for Incomer of MCC / PDB / MLDB

- Cable size for incomer of MCC & PDB shall be selected on the basis of current rating corresponding to MD and voltage drop.
- Cable size for incomer of MLDB shall be selected on the basis of current rating corresponding to lighting transformer and voltage drop.

Cables for LT & HT Motors

- Cable size for LT motors shall be selected on the basis of rated nameplate current and starting & running voltage drop as per specification.
- Cable size for HT motors shall be selected on the basis of rated nameplate current, starting & running voltage drop as per specification and short circuit capacity of the system. The cable size shall be calculated based on the breaker opening time of 0.25 seconds.

Cables for Illumination System

- The minimum size of the cable for feeding power to SLDB or MCBDB having 32A incomer shall be 4x25sq.mm
- Cable size for SLDB (or MCBDB) to light fittings shall be 3x2.5sq.mm. or 4x2.5sq.mm as per the configuration of fittings.
- In case of concealed wiring, single core, PVC insulated, stranded copper conductor wire of size 2.5 sq mm in MS conduit shall be used. For utility sockets, cable size shall be 4sq.mm.

Cables for Automation System

- All Cables connecting I/Os from field to PLC or remote I/O panel shall be of stranded copper conductor of type YRY as per IS: 1554 and of size 2.5/1.5 sq.mm.
- Communication bus shall be laid in GI pipe. The route for redundant communication bus shall be different.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

5.0 CABLES SPECIFICATION

5.1 HT Power Cables for Voltage up to 33kV.

Sl.No.	Parameter	Description
1.0	Voltage Grade	33 kV (UE)/ 11 kV (UE)/ 6.6 kV (UE) / 3.3 kV (UE) as applicable
2.0	Duty type	Heavy duty
3.0	No. of cores	3 cores
4.0	Reference standard	IS:8130 – 1984 IS:5831 – 1984 IS:3975 -1988 IS:1554, part - 1, 1988 IS:3961 (Part-II) - 1967. IS:7098 Part-I & II IEC-60502
5.0	Conductor type	Compact circular stranded (rm/V) aluminum conductor, with extruded conductor shielding of semi conducting material. Conductor construction as per IS 8130-1984.
6.0	Insulation type	XLPE insulated, with insulation shielding over individual cores, consisting of extruded semi conducting compound , followed by lapped semi conducting material and copper tape (non magnetic) metallic screen , cores stranded together with a holding tape provided with a common covering of extruded inner sheath of type ST2 compound . The cable shall conform to IS:7098(Part-2)-1985.
7.0	Armour	Galvanized steel wire armoured. For multi core cables, armouring shall be applied over the inner sheath of flat steel wires (strips) . Round steel wire armouring can also be offered. For single core armoured cables non-magnetic armour consisting of hard drawn flat or round aluminium wires shall be provided.
8.0	Outer sheath	PVC outer sheathed of type ST2 compound. Black in colour. Suitable chemicals shall be added into the PVC compound of the outer sheath to protect the cable against rodent and termite attack.
9.0	Miscellaneous	Copper screen shall be suitable to carry 1 KA E/F current for one second.
10.0	Temp. rise on continuous load	90 deg.C



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

11.0	Oxygen index of outer sheath material for XLPE Cable	Shall not be less than 29 at 27 ± 2 deg. C.
12.0	Temperature index	Not below 250°C.
13.0	Max. conductor withstand temperature during short circuit.	250°C

5.2 LT Power Cables of 1.1kV Voltage grade.

Sl.No.	Parameter	Description
1.0	Voltage Grade	1.1 kV grade
2.0	Duty type	Heavy duty
3.0	No. of cores	<ul style="list-style-type: none"> - 3.5 / 4 core cables shall be used for motor feeders. - For other consumers or for power supply to other panel 4 core (upto conductor size of 50 sq.mm) or 3.5 core (for conductor size beyond 50 sq.mm) cables shall be used.
4.0	Reference standard	IS:8130 – 1984 IS:5831 – 1984 IS:3975 – 1988 IS:1554, part - 1, 1988 IS:3961 (Part-II) - 1967. IS:7098 Part-I & II IEC-60502
5.0	Conductor type	<ul style="list-style-type: none"> - Plain aluminium conductor. - All power cables of size 10 sq.mm and above shall have standard sector shaped (sm) or compact circular stranded (rm/V) or circular stranded (rm) aluminum conductors as applicable. - The conductors will be H2 or H4 grade. - The solid conductor shall be class - 1 and the stranded conductor will be class - 2. - The conductors shall be solid for conductor of nominal area upto and including 6 sq. mm. and stranded beyond 6 sq. mm. Conductors of nominal area less than 25 sq. mm. shall be circular or shaped. Cables with reduced neutral conductor shall have sizes as per Table 1 of IS 1554 (Part-1) -1988.
6.0	Insulation type	<ul style="list-style-type: none"> - XLPE insulation - The insulation compound shall be conforming to IS:7098 (Part I) - 1988.
7.0	Inner sheath	<ul style="list-style-type: none"> - For armoured / unarmoured cables a tough inner sheath of heat resisting PVC compound

		(wrapped / extruded as per size),Type ST2 as per IS 5831 . - Black in colour.
8.0	Armour	- Galvanised steel wire armour shall be used for 3Cx10 sq.mm / 4Cx6 sq.mm cable. - Galvanised flat steel wires (strips) armour shall be used for bigger size cables. - Single core armoured cables are provided with non-magnetic armour consisting of hard drawn flat or round aluminium wires.
9.0	Outer sheath	- For armoured / unarmoured cables a tough outer sheath of heat resisting PVC compound (Type ST2 as per IS 5831) . - Black in colour .
10.0	Miscellaneous	- Minimum cross - sectional area of the power cable shall be 6 sq.mm in case of aluminium conductor and 2.5 sq.mm in case of copper conductor. - Power cables shall be selected from core sizes of 6, 10, 16, 25, 50, 70, 120, 150, 240 & 300 sq.mm (Aluminium conductor).
11.0	Temp. rise	Shall be limited to 90 deg.C.
12.0	Core identification	- Cable identification will be provided by embossing on the outer sheath the following: • Manufacturer's name & trade mark • Voltage grade • Year of manufacture • Type of insulation • R,Y,B for phases . • Black for neutral (fourth core)

5.3 LT Control Cables of 1.1kV Voltage grade.

Sl.No.	Parameter	Description
1.0	Voltage Grade	1.1 kV grade
2.0	Duty type	Heavy duty
3.0	No. of cores	As per requirement .
4.0	Reference standard	IS:8130 – 1984 IS:5831 – 1984 IS:3975 -1988 IS:1554, part - 1, 1988 IS:3961 (Part-II) - 1967. IEC-60502
5.0	Cross sectional area	Shall be 1.5 / 2.5 sq.mm.
6.0	Conductor type	Solid annealed circular stranded copper conductor.
7.0	Insulation type	PVC Type- C insulated
8.0	Inner and outer sheath	- Type ST-2 PVC shall be used for inner sheath . - Type ST-2 PVC shall be used for outer sheath .



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

		- Both inner and outer sheath shall be extruded type upto 7 core and after 7 core inner sheath shall be wrapped ..
9.0	Armour	- Galvanised steel wire armour / galvanised steel strip
10.0	Spare Cores	- 3, 5 and 7 cores cables shall have at least one spare core, cables with 10 core and above shall have at least 2 spare cores.
11.0	Miscellaneous	- The Tenderer shall furnish necessary calculations to show that the selected cable satisfy the criteria including for voltage drop. - Cables for temperature detectors shall be screened type of required technical parameters with core size not less 1.5 sq.mm.
12.0	Core identification	- Cable identification will be provided by embossing on the outer sheath the following: <ul style="list-style-type: none"> • Manufacturer's name & trade mark • Voltage grade • Year of manufacture • Type of insulation - Cores of the cables upto 5 cores shall be identified by colouring of insulation. - For cables having more than 5 cores, core identification shall be done by numbering insulation of core sequentially. - All the numbers shall be of same colour, which shall contrast with the colour of insulation. - Numbers shall be written in figures and words both - The numerals shall be legible and indelible. - The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. - When number is a single numeral a dash shall be blacked underneath. - If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. - The spacing between consecutive numbers shall not exceed 100 mm.

5.4 LT Power Screened/special cables.

Sl.No.	Parameter	Description
1.0	Voltage Grade	1.1 kV grade
2.0	Duty type	Heavy duty
3.0	No. of cores	As per requirement .
4.0	Cross sectional area of conductor & Armouring	- Shall be 1.5 sq.mm & Armoured . - For weighing system 1.0 sq mm un-armoured

		cables in GI conduit from field to controller panel shall be provided.
5.0	Conductor type	<ul style="list-style-type: none"> - Solid annealed circular stranded copper conductor. - For twisted pair cables , the conductors shall be of stranded tinned copper having proper flexibility to provide limpness and extended flex-life as required for these small diameter cables.
6.0	Insulation type	<ul style="list-style-type: none"> - PVC insulated, Type A - Type ST-1 PVC shall be used for inner sheath. - Both inner and outer sheath shall be extruded type. - Outer sheath made of PCP (Chloroprene rubber), abrasion resistant, oil resistant and flame retardant conforming to IS:434 –1964 (Part - I), as amended upto date.
7.0	Screen	<ul style="list-style-type: none"> - Tinned annealed copper mesh over metallised tape , in a close woven braid .
8.0	Shielding	<ul style="list-style-type: none"> - Special aluminium foil to provide 100% shield coverage for optimum protection against radiated interference and ingress of audio and radio frequencies. - It shall have shorting fold for metal to metal contact and isolation fold to prevent adjacent shields from shorting to one another, so as to improve the voltage breakdown characteristics. The drain wire shall be of stranded tinned copper wire of 0.518 sq. mm. (20 AWG) cross-section.
9.0	Spare Cores	<ul style="list-style-type: none"> - 20% spare cores but not less than 2 spares shall be provided in all the multi core cables .
10.0	Reference standard	As per relevant IS with latest amendments
11.0	Miscellaneous	<ul style="list-style-type: none"> - The Tenderer shall furnish necessary calculations to show that the selected cable satisfy the criteria including for voltage drop. - Cables for temperature detectors shall be screened type of required technical parameters with core size not less 1.5 sq.mm. - The special twisted paired cables shall be of the type to provide balanced signal transmission and shall have good noise immunity.
12.0	Core identification	<ul style="list-style-type: none"> - Cable identification will be provided by embossing on the outer sheath the following: <ul style="list-style-type: none"> • Manufacturer's name & trade mark • Voltage grade • Year of manufacture • Type of insulation - Cores of the cables upto 5 cores shall be identified by colouring of insulation. - For cables having more than 5 cores, core



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

		<p>identification shall be done by numbering insulation of core sequentially.</p> <ul style="list-style-type: none"> - All the numbers shall be of same colour, which shall contrast with the colour of insulation. - Numbers shall be written in figures and words both - The numerals shall be legible and indelible. - The numbers shall be repeated at regular intervals along the core, consecutive numbers being inverted in relation to each other. - When number is a single numeral a dash shall be blacked underneath. - If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. - The spacing between consecutive numbers shall not exceed 100 mm.
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5.5 Flame retardant low smoke (FRLS) cables.

Sl.No.	Parameter	Description
1.0	Voltage Grade	1.1 kV grade
2.0	Reference standard	Category AF as per IS : 10810 ASTM-D 2863 (Critical Oxygen Index) ASTM-D 2863 (Temperature Index) ASTM-D 2843 (Smoke density) IEC 754-1 (Acid gas generation) IEEE-383 (Flammability test on group of cables) Swedish chimney test SS 424175, class F3. (Flammability test) IEC 332-1 (Flammability test) IEC 332-3 (Flammability test) IS 5831 (Fire resistant test)
3.0	Duty type	Heavy duty
4.0	No. of cores	Single or multicore as per requirement
5.0	Cross sectional area	As per requirement .
6.0	Conductor type	Annealed tinned copper conductor
8.0	Insulation type	XLPE insulation
11.0	Sheath	Specially designed with thermoplastic or thermosetting materials , superior resistance to ignition and flame propagation with smoke emission and toxicity or corrosive characteristics Flame retarded Oil resistant
12.0	Armouring	GI wire / strip armoured as per requirement and size (as specified in respective TS)
13.0	Test values	Critical Oxygen Index : Minimum 29 Temperature Index : Minimum 250 deg. C Smoke density : Minimum average light



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

			transmission of 40%
	Acid gas generation maximum		: HCl gas released 20%
	Flammability test on group of cables		: As per standards mentioned
	Flammability test		: As per standards mentioned
	Fire resistant test		: As per standards mentioned

5.6 Details to be furnished in datasheet of HT & LT Cables:

- i) Name of manufacturer
- ii) Type
- iii) Applicable standards
- iv) Voltage grade
- v) Maximum temperature of conductor
 - Continuous rating
 - Short circuit withstand rating
- vi) Conductor
 - Material & type
 - Type & shape of conductor
 - Cross sectional area
 - Number and diameter of wire in each conductor
- vii) Insulation
 - Material & type
 - Nominal thickness
 - Identification of cores
- viii) Laying up
 - Direction of lay
- ix) Inner sheath
 - Material & type
 - Minimum thickness
- x) Armour
 - Material & type
- xi) Outer sheath
 - Material & type
 - Colour
 - Minimum thickness
 - Embossing/printing
 - Diameter of cable
 - Sequential length marking
- xii) General
 - Total quantity
 - Packing length
 - Net weight
- xiii) Acceptance and routine tests
 - Tensile strength of insulation & sheath



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- Elongation at break of insulation & sheath
- Volume resistivity
- DC Resistance of conductor at 20°C
- High voltage at room temperature
- xiv) Other parameters
 - Short circuit rating of conductor for 1 sec
 - Minimum permissible bending radius
- xv) Current rating
 - Direct in ground
 - In air
 - In Duct

6.0 GENERAL REQUIREMENT

The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installations.

They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE /PVC insulated L.T. power cables shall withstand without damage a 3 phase fault current for 1 second as specified in “Design Basis” at rated conductor temperature (70° C for PVC insulated cables and 90°C for XLPE insulated cables).

The XLPE insulated cables shall be capable of withstanding a conductor temperature of 250°C during a short circuit without any damage. The PVC insulated cables shall be capable of withstanding a conductor temperature of 160°C during a short circuit.

The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects.

Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.

The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.

When armouring is specified for single core cables, the same shall consist of aluminium wires/strips.

7.0 CABLE DRUMS

7.1 Cables shall be supplied in returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.

7.2 Standard lengths for each size of power and control cables shall be 500/1000 meters. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard

drum length. The owner shall have the option of rejecting cable drums with shorter lengths. However if shorter length of cable (Not standard as specified) is required shall be provided by the contractor in drums.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Maximum, One (1) number non standard length of cable size(s) may be supplied in drums for completion of project.

7.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

7.4 Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stencilled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

7.5 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

8.0 TRANSPORTATION AND UNLOADING

All cables shall be shipped and transported on cable drums of adequate size. Drums shall be lifted by means of a crane or by means of a loading ramp. Throwing and dropping down of cable drums shall be strictly avoided. In order to prevent drums moving during transportation, these must be securely wedged to prevent movement. Before unloading it is necessary to verify that the drum is received in proper condition. The directional arrow of the drums has to be observed during rolling. Empty cable drums have to be stored on a suitable central store place. Retransport to the cable manufacturer of returnable drums is the Contractor's responsibility.

9.0 DRAWINGS AND DOCUMENTS

Following minimum information shall be furnished with bid:

- a) Data sheet for cables
- b) Type Test Reports of cables
- c) Catalogues of cables

The following drawings (in three sets) shall be submitted for approval/review within 3 weeks of award of contract.

- a) Data sheet for cables
- b) Type Test Reports of cables

10.0 INSPECTION

Inspection and testing of equipment shall be carried out by the owner/ consultant at the manufacturer's works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approval draws, and reference national/ international standards.

The inspector shall have free access to the manufacturer's works for the purpose of inspecting the process of manufacture in all its stages and he shall have the power to reject any material which appears to be unsuitable description or of unsatisfactory quality. The vendor shall give at least 2 weeks advance notice to the purchaser regarding the date of testing to enable them or their representative to witness the tests.

The contractor shall submit Quality Assurance Plan (QAP) for respective equipments within 3 weeks of award of contract.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

QAP shall be prepared and furnished by the contractor in PMC Form No. 11.20(4.4) F-10 along with their internal in process quality checks.

After completion of manufacture of cables and prior to despatch, the cables shall be subjected to type, routine, acceptance and special tests as per the approved QAP. Purchaser / Consultant reserve the right to witness all tests with sufficient advance notice from vendor.

All routine tests, acceptance tests, type tests and additional type tests for improved fire performance shall be carried out on cables as per IS:1554 Part 1 and IS:7098 Part – 2 and international standards as may be applicable.

Routine test and type test certificate shall be furnished for review. Acceptance test shall be witnessed by owner/consultant.

The following special tests may be performed on the cables as per sampling plan and as may be applicable as per approved QAP. These tests will be witnessed by Purchaser / Consultant before despatch of cables.

- a. Accelerated water absorption test for insulation as per NEMA – WC – 5. (For PVC insulated cables) and as per NEMA WC – 7 (for XLPE insulated cables). Sampling for this test to be done randomly and once for each size per order wise provided outer sheath remains same.
- b. Dielectric Retention Test: The dielectric strength of the cable insulation tested in accordance with NEMA WC – 5 at 75 +/- 1 deg C will not be less than 50% of the original dielectric strength (For PVC insulated cables.) Test certificates with respect to this test from recognized testing laboratory to be furnished for review by purchaser/ consultant before inspection of cables. In case test certificates are not available, test to be conducted by the manufacturer at his own cost in any recognized test laboratory before inspection of cables.
- c. Oxygen index test: The test will be carried out as per ASTM D 2863 or applicable Indian Standard. Sampling to be done for every offered lot / size as per sampling plan.
- d. Flammability test: The test will be carried out on finished cable as per IS-10810 (Part 61 & 62). Sampling for these tests to be done randomly once for each size per lot provided outer sheath remains same.
- e. Test for rodent and termite repulsion property: The vendors will furnish the test details to analyse the property by chemical method. Sampling will be done for every offered lot / size as per sampling plan.

1. TYPICAL CALCULATIONS: (For sizing and design)

a) Selection criteria for HV/MV cable size for primary distribution:

i) Temperature of conductor just prior to short circuit:

- 1) With XLPE insulation - 90 Deg. C
- 2) With PVC insulation - 70 Deg. C

ii) Maximum permissible conductor temperature during short circuit:

- 1) With XLPE insulation - 250 Deg. C
- 2) With PVC insulation - 160 Deg. C



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- iii) Volumetric specific heat of the conductor:
- 1) With Aluminium conductor - $2.5 \times 10 \text{ J/Deg. C/MM}$
 - 2) With Copper conductor - $3.45 \times 10 \text{ J/Deg. C/MM}$
- iv) Reciprocal of temperature co-efficient of resistance at 9 Deg. C:
- 1) With Aluminium conductor - 228
 - 2) With Copper conductor - 234.5

Short circuit current rating at different duration may be calculated as – I_{sh} (for t duration) =

I_{sh} (for 1Sec.) I_{sh} for 1 Sec. Duration (kA)

t = Time duration required to be calculated of short circuit in Sec

Formula for calculating HT Cable size:

With Aluminium cond./XLPE insulated cable = $I_{sh} \sqrt{t} / 0.094$ With Copper

cond./XLPE insulated cable = $I_{sh} \sqrt{t} / 0.143$

b) Calculation for number of runs of incoming cable:

Maximum demand (MD) on MCC = (Total working load x LF)/DF Where

LF – Load factor

DF – Demand factor

Current based on maximum demand (I_M) = $(\text{KWX}1000) / (1.732 \times V \times \text{pf})$ Current rating as

per catalogue (In air) for selected size of cable - I_C Derated current rating (I_{CD}) = Derating

factor X I_C

Minimum no. of runs (n) = I_M / I_{CD}

c) Voltage drop calculation:

Voltage drop of cable = $(\sqrt{3} \times I_M \times Z_{cab} \times L) / n$ Volts. Where

I_M - Current based on maximum demand Z_{cab} – Impedence of cable

L – Route length of cable N – no. of runs



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SPECIFICATION FOR PDB PANEL

SPECIFICATION NO. –



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

CONTENTS

SL. NO.	DESCRIPTION
1.0	INTENT
2.0	CODES & STANDARDS
3.0	TECHNICAL REQUIREMENTS
4.0	AUTOMATIC POWER FACTOR CORRECTION EQUIPMENT
5.0	CONTROL EQUIPMENT
6.0	FEEDER TYPE
7.0	SPECIAL TOOLS
8.0	PAINTING
9.0	TESTS
10.0	DRAWINGS
11.0	PACKING
12.0	COMPLETENESS OF EQUIPMENT



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 INTENT

- a. The intent of this standard specification is to define the general requirements for design, manufacture, assembly and testing at manufacturer's works, packing, transportation and receipt at site with all materials and accessories of PDB Panel.
- b. **Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:**
1. **Details of PDB – Single /double front, Draw out/ Non-drawout, Busbar details – Aluminium/copper etc.**
 2. **Single incomer/ double incomer with buscoupler along with ratings.**
 3. **Outgoing feeder details (Ratings & Quantity)**
 4. **Make list of PDB and its components**
 5. **Quantity & location of PDB**

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 CODES & STANDARDS

IS: 375	-	Marking and arrangement for switchgear busbars, main connections and auxiliary wiring
IS: 722	-	AC Electric meters
IS: 2147	-	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS: 2705	-	Current transformers
IS: 3156	-	Voltage transformers
IS: 3231	-	Electrical relays for power system protection
IS: 4237	-	General requirements for switchgear and controlgear for voltages not exceeding 1 000 volts ac or 1 200 volts dc



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

IS: 8623	-	Specification of low voltage switchgear and controlgear assemblies	
IS: 10118	-	Code of Practice for selection, installation & maintenance of switchgear & controlgear.	
IS: 13947	-	Specification of low voltage switchgear and controlgear	
IEEE	-	Recommended practice for electrical power distribution (Std. 141) for industrial plants	(Std.)

3.0 TECHNICAL REQUIREMENTS

3.1 Construction features

- 415V, 3 phase, 4 wire, 50 kA (short time rating for 1 sec.) indoor type.
- Single front/ double front design(as per TS), Draw –out / Non-draw out (as per TS), free standing, compartmentalized, floor mounting type suitable for both front and rear access.
- The panel shall be extendable on both sides at site through provision of coupling holes at bus end & removable type side end covers.
- Unless specified in TS, the PDB shall have one incomer.
- Incoming Circuit breakers (ACBs – 800A & above / MCCBs from 500A upto 630A with contactor) shall be mounted on fully draw-out truck with service, test and isolated positions and complete with following safety interlocks and safety shutters with padlock facility;
 - It shall not be possible to move the truck in or out of cubicle when the breaker is closed.
 - CB compartment door shall be mechanically interlocked so that it will not be possible to close the CB in plug position when the door is open.
 - It shall not be possible to push the truck in close position if either of the safety shutter is not free and not in close position.
- Incomer MCCB below 500A rating shall be a non-drawout panel.
- Outgoing feeders shall be drawout / non-drawout type as per TS.
- Shall have an integral base channel.
- A transport section shall not exceed 3 vertical panels (Limited to 2400 mm).
- Rear face of each panel cubicle shall be openable and accessible for maintenance purpose. Panel shall have removable type bolted door on the rear side.
- Lifting facility shall be provided for each section.
- Dust & vermin proof design.
- Degree of protection for enclosure kept in a premise shall be IP 52 as per IS: 13947 – 1993 Part – 1.
- Incomer shall have analogue type of Voltmeter & Ammeter with selector switches. All feeders shall have ON/OFF/TRIP lamps. Each Incomer panel shall have 3 nos lamps for R/Y/B and 6 nos lamps for Breaker ON/OFF/TRIP and for breaker fault conditions.
- Shall have isolated busbar chamber for main busbar at the top, running through out the length of the



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- board. Chamber shall have removable cover.
- Cable alley shall have sufficient space for aluminium power cables and bottom cable chamber shall be left free completely isolated from the vertical busbars.
 - Busbars shall have same cross section throughout the length. Rating of the neutral busbar shall be 50% of the main busbar. Earth bus bar shall run in bottom chamber throughout the length of the panel.
 - Polyurethane/ Neoprene gaskets shall be used for cable alley doors, busbar chamber covers to ensure tightness and making it dust proof.
 - Feeder module doors and cable alley doors shall open in opposite direction for providing more working area for maintenance purpose.
 - Each feeder module shall have door interlock, defeat interlock and padlocking facility.
 - All outgoing feeders from PDB's shall be TPN MCCB with minimum 2 NO+2NC auxiliary contacts.

3.2 Busbars & Supports

- Main busbars shall be made of high conductivity EC grade aluminium alloy equivalent to E91E WP (IS-5082/1981) or electrolytic copper as per IS-1897-1983.
- Three phase, neutral (with atleast 50% rating of main buses) and continuous earth bus. Bus bar shall be provided with proper grade & colour of heat shrinkable sleeve.
- Rating of horizontal buses shall be same as that of incomer circuit breakers and vertical run shall be same as that of outgoing breaker rating.
- Temperature rise of bus bars shall not be more than 40 deg. C above an ambient of 50 deg. C.
- Three phase and Neutral bus shall have facility for connection with earth bus.
- Shall be heat shrinkable PVC shrouded except at the points of tap-off. The bus bars shall be colour coded for phase identification.
- All incoming and outgoing bus bars shall be TP&N type and shall be sleeved.
- Busbars shall be housed in totally enclosed compartments (Bus bar chambers) having removable type covers for easy maintenance.
- Power and control bus bars shall be segregated. Main bus bars shall run throughout the length of transport section and vertical bus bars throughout the height of PDB.
- Busbar joints shall be of bolted type with suitable spring washers to ensure tight fittings. Bolts and washer shall be galvanized or cadmium plated.
- GI earth strip of size 50 x 6 mm or equivalent shall be run at the bottom of PDB with a provision of a link for connecting to neutral bus bar.
- Provision shall also be made for terminating the 4th core of incoming & outgoing cables.
- Bus bars shall be sized for the current rating specified (with temperature derating) to withstand a short circuit current of 50kA for 1 sec.
- Bus bar supports shall have adequate mechanical strength, high dielectric strength, and low moisture absorption characteristics.
- Bus bar supports shall be rigidly held to the frame work of PDB and shall be so spaced as to ensure rigid support for bus bars.
- Bus bar supports shall be designed to withstand thermal and dynamic stresses resulting from specified short circuit current.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- Min. clearance between live parts shall be 25 mm and live to earth 19mm.
- All core type CTs mounted on bus bars shall be supported separately and not supported on bus bars. CT secondary-connecting cables shall be properly dressed and clamped such that these do not hang loose / pass directly over bus bars.

3.1 Circuit Breaker

3.3.1 Electrical Features

- Air break triple pole (4 pole in case of DG power incomer) drawout type conforming to IS 13947 for incomers & buscoupler for ratings of 800A & above.
- MCCB TPN, air break type with independent manual quick make and quick break type for incomer ratings of upto 630A and all outgoing feeders. MCCB shall withstand the fault current envisaged for 415V system. MCCB shall have set point adjustable feature for instantaneous thermal overload & shall have trip coil.
- Under voltage release provision shall be kept in ACB.
- Electrically operated mechanism for incomers & Bus-couplers. Manual operated mechanism for outgoing feeders or as specified
- Incomer shall have analogue type of Voltmeter & Ammeter (144 X 144 sq.mm) with selector switches. All outgoing feeders shall have ON/OFF/TRIP lamps with ammeters of 96 X 96 sq.mm.
- All outgoing feeders shall have TPN.
- Rated continuous current as specified:
 - Symmetrical breaking capacity and 1 second rating of the breaker not less than the system short circuit level specified.
 - Making capacity 2.55 times breaking capacity.
- Auxiliary contacts : 4 NO + 4 NC minimum, convertible from NO to NC and vice versa at site.
- Ratings :

Continuous	10 amps
AC 11	4 amps at 240 V
DC 11	0.5 amps at 110 V

3.3.2 Moulded Case Circuit Breaker (MCCB)

MCCB shall conform to IS/IEC 60947-2 and the rating shall be as per SLD with ICS=ICU=100% for the complete range. MCCBs must be suitable for “Positive Isolation” as per IEC 60947-2 and should have Class-II Front Facia as per IEC 60441. MCCB rated upto 250 A shall have Thermal Magnetic release or Microprocessor based release with variable O/L, S/C& E/F settings. Accessories should be continuously rated with Shunt Trip Coils and shall be snap fit type and should be common throughout the range. MCCB shall have Cross Bolted Termination to withstand higher short circuit Levels.

Operating handle, door interlock and padlocking at ON/OFF position shall be provided. At least 1 NO and 1 NC auxiliary contacts shall be provided.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3.3.3 Air Circuit Breaker (ACB)

3.3.3.1 Electrical Features

- Air break TPN (4 pole in case of DG power incomer) drawout type conforming to IS 13947.
- Motor operated spring charge mechanism
- Rated continuous current as specified.
- Symmetrical breaking capacity and 1 second rating of the breaker not less than the system short circuit level specified.
- Making capacity 2.55 times breaking capacity.
- Performance category : P2
- Auxiliary contacts : 4 NO + 4 NC minimum, convertible from NO to NC and vice versa at site.

Ratings :

Continuous	10 amps
AC 11	4 amps at 240 V
DC 11	0.5 amps at 110 V

3.3.3.2 Operating Mechanism

- Electrically operated mechanism for incomers & Bus-couplers
- Manual operated mechanism for outgoing feeders or as specified with MCCB + Contactor as per SLD/TS.
- Spring charged stored energy mechanism to ensure high speed closing and tripping independent of the operating forces.
- Anti pumping and trip free feature
- Emergency tripping by mechanically operated trip push button (shrouded to prevent accidental closing) acting directly on the trip bar.
- Closing operation of the breaker to charge the tripping spring, ready for tripping.
- Mechanical indication to show :
 - Closing spring charged
 - Breaker ON/OFF/TRIP
 - Breaker to close only when spring fully charged
- Non-reset type operation counter
- For manually operated breakers (if specified).
 - Independent manual charging of closing spring and closing by handle.
 - Alternatively, closing by mechanical push button with spring previously charged by handle.
- For electrically operated breakers :
 - Charging of closing spring by motor
 - closing by closing coil
 - spring charging motor and closing coil suitable for rated control voltage (240 AC unless otherwise specified).
 - One opening and one closing operation without control supply.
 - Provision also for manual closing with spring charging motor automatically decoupled as soon as charging handle is inserted.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3.3.3.3 Drawout Features

- 3 distinct positions viz. service, test, and isolated with the door closed.
- Mechanical position indication and locking/latching facility for all 3 positions.
- Power connections -self aligning, plug-in type.
- Control connections - sliding or plug socket type, mechanically coded, to prevent wrong insertion.
- Automatic safety shutters to prevent accidental contact with live parts when the breaker is withdrawn.

3.3.3.4 Safety Interlocks

- It shall not be possible to close the breaker in any intermediate position other than the 3 fixed positions.
- With the breaker closed, it shall not be possible to rack it in from any of the 3 position to another.
- Mechanical stopper to prevent accidental falling while withdrawing.
- It shall not be possible to rack in the breaker from isolated to 'test' position with the door open together with provision for defeat of this interlocking, however, it shall be possible to close the door only when the breaker is brought back to 'isolated' position.
- It shall be possible to open the door only when breaker is OFF and in 'Isolated' position.
- Remote closing of breaker is not permitted with door open.
- Insertion of breaker into 'Service' position shall not be possible if the shutters are not free.

3.3.3.5 Microprocessor based releases

General

- The control unit shall be interchangeable on site for adaptation to changes in the installation.
- Sensors shall be non-magnetic or of the Rogowsky type for accurate current measurements.
- The control unit shall measure the true RMS value of the current.
- The control unit shall comprise a thermal memory to store temperature-rise data in the event of repeated overloads or earth faults. It shall be possible to disable this function if necessary.

Protection

- The control unit shall offer the following protection functions as standard:
 1. Long-time (LT) protection with an adjustable current setting and time delay;
 2. Short-time (ST) protection with an adjustable pick-up and time delay;
 3. Instantaneous (INST) protection with an adjustable pick-up and an OFF position.
- Digital Microprocessor based relay shall be used to obtain data processing regarding protection.
- It shall display the phase current with highest load.
- It shall also express the true energy content of the current.
- Current and time-delay settings shall be indicated in amperes and seconds respectively on a digital display. Acknowledgement that the setting change should translate to the trip threshold.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- Earth-fault protection with an adjustable pick-up and time delay shall be provided if indicated on the single-line diagram.

3.3.3.6 Communication

- The circuit breaker shall be capable of communicating the following data via a bus:
 - Circuit-breaker status (open/closed, service/test/isolated, tripped on a fault, ready to close);
 - Control-unit settings;
 - Tripping causes;
 - The measurements processed by the control unit: current, voltage, frequency, power
- It shall be possible to remotely control the circuit breaker. All Protection parameters are adjustable from Remote.
- RS-485 Standard serial interface shall be provided for communication of microprocessor based relay
- It shall be possible to remotely modify circuit-breaker settings:
 - Settings within the range defined by the switches on the front panel of the control unit;
 - Settings of the protection functions and the alarms.
 - Communications functions shall be independent of the control unit

3.2 Internal Panel Wiring & Terminal Blocks

- Suitable provision shall be made to terminate control / power connections near the respective module. The terminals selected shall be suitable for the termination of armoured cables, as per the details of cable required. Adequate space shall be kept for cabling.
- Feeders up to 100A shall be terminated to terminal block located in cabling chamber and feeders above 100A rating shall be terminated directly to suitably staggered taped bus bars.
- PDB shall be completely factory wired, ready for connecting to equipment.
- Power circuit wiring shall be with 1100 V grade single core stranded, PVC insulated copper cable of minimum 4 sq. mm or aluminium cable of 6 sq.mm..
- Control circuit wiring shall be with 1100 V grade multi strand, PVC insulated copper cable of 2.5 sq. mm.
- Internal control wiring shall be laid in PVC ducts with detachable snap - on covers and there shall be enough length to avoid the necessity to stretch the cables for door movement/connection, disconnection or changing.
- Wires identified at each end in accordance with schematic diagrams by interlocked type ferrules.
- Necessary cable clamping arrangement shall also be provided in the cable alley/chamber inside compartment on perforated sheet steel section.
- All connections external to a feeder, all the auxiliary contacts of the LT breaker, and all spare contacts of the relays shall be wired on to the terminal blocks.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- Interconnection between panels of adjacent shipping sections to be brought out to a separate terminal block, wires for interconnection properly labeled, looped and bunched inside the panel for connection at site.
- All terminals, as well as terminations, at various control devices inside the compartment shall be provided with interlocking type ferrules having engraved numbers. Terminals having connections from other modules shall be marked with red ferrules.
- There shall be no joints or tappings between two terminations. No more Than two connections shall be made to any terminal.
- 20% spare terminals shall be provided in each control terminal block.
- The wiring shall be terminated in the respective terminal with suitable crimp type sockets.
- Interlocking type ferrules for identification shall be provided.
- All spare contacts to be wired to terminal block.
- Interpanel wiring shall be through horizontal bus bar chamber.
- All holes or tubes for wiring runs shall be bushed and shall have room for reasonable additions.
- All power cable terminal blocks / boards shall be stud and nut type with phase barriers.
- For higher rated feeders, suitable staggered extension links shall be provided to permit direct termination of cables.
- Cable supports / clamps shall be provided in cable alley.
- Removable cable gland plate shall be provided.
- All cable termination nut / bolts and washers (for all cables at panel bus bar /link inside all the supplied panels must be supplied as part of Tenderer's panel supplier's scope.
- Double compression type GI / brass glands, accessories including tinned copper lugs to outgoing cable sizes to be supplied loose.
- The color-codes for the wires shall be as follows:

415V, 3phases	Red, yellow & blue
Neutral	Black
Earth	Green
Single phase - line	Red
110V AC - line	Brown
24V DC +ve	Orange
-ve	Black



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3.3 Control Transformers

415V/230V Control transformers of adequate rating (Minimum 2.5 kVA each) shall be provided for 230 V AC control supply for each PDB. Higher rating shall be selected based on actual requirement with 50% margin and voltage drop in control transformer shall be less than 3% at peak KVA requirement during coil pickup.

MCB& fuse shall be provided for primary side of control transformers. MCB of suitable rating shall be provided on the secondary side.

Voltmeter class 1.5 and scale 0-250 V.

Control transformer shall be horizontally mounted in one of the bottom compartments with adequate ventilation.

The transformer shall be double wound, dry type with class E insulating materials. The control supply for the motor feeders shall be fed through suitable rated MCBs.

Control transformers shall be provided with +/- 5% and +/-10% voltage taps on 415 V side.

The control bus of the PDB shall be electrolytic grade aluminium/copper only and will be designed to carry the transformer rated secondary current as well as withstand the available short circuit level. Control buses of two sections shall be connected through sectionalising switch.

Indication lamps shall be connected to 240V AC supply.

Isolation arrangement shall be provided on each panel to facilitate fault location and testing. Separate fuses shall be provided for spring charging motors, for indication lamps and for closing/tripping circuits of each cubicle.

3.4 Inscriptions

Identification labels shall be provided for each PDB as well as for each compartment, control device and other components.

PDB designation at the top of central panel with letters of 25 mm (min.) height.

Anodised Al. Plates (Black background and white lettering) for each feeder inscriptions with letters of mm. 6 mm height for each module on door.

Each component shall be identified as per schematics by good quality polyester film stickers on components and by painting in a conspicuous place on the panel body.

Terminal blocks shall be identified as per schematics with stickers / stenciling by black paint.

Danger boards as per IS on front & rear end of PDB in English, Hindi & local language.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3.5 Earthing

A continuous earth bus shall be provided for the PDB at the bottom with an earthing bolt at each end. Bolted joints with tooth spring washers shall be provided for good earth continuity.

Provision shall be made for connecting 4th core incoming and outgoing cables.

The earth bus shall be of aluminium having the same size as that of neutral bus bar at the top.

Neutral and earth busbars shall be connected through a link.

Electrical equipment shall be interconnected with earth grid using minimum size 50 x 6 GI strip or equivalent.

Earthing shall conform IS: 3043 - 1987, IE rules and statutory regulations.

Internal earthing network shall be connected at two places minimum to the external- earthing network.

5.0 Feeder Types

The PDB'S shall be generally used to feed all items such as Sockets /starters / MCBs/ Other PDB_ supply panels / mobile sockets / non-UPS supply etc.

The following types of feeders shall be envisaged in PDB.

Type 'A' Incomers

- Draw out design
- Air circuit breaker of 800 / 1200 A / 1600 A rating with Microprocessor based trip release for O/L, S/C& E/F.
- Incomer from transformer or incomers from DG set can be switched on one at a time.
- 415V, 3 Ph, 250/400/630 Amps, rated Moulded case circuit breaker with Microprocessor based trip release for O/L, S/C& E/Fwith AC3 duty contactor.
- Current transformers to read phase currents as per PDB rating.
- Relay as per SLD
- Voltmeter with 3-position selector switch
- Digital Ammeters
- Phase (R, Y, B) Indication lamps with fuses.
- ON/OFF/Trip indication lamps (LED type).
- Current transformers for protection and measurement



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Type 'B' Control Section

- Dry type control transformer, 415 / 240V with + 2.5 and + 5% tappings on primary, of required rating (minimum 2.5 kVA).
- MCB on primary side and secondary side of transformer.
- Control supply healthy (lamp) indication.

Type 'C' (Power supply Feeder module)

- Heavy duty fuse switch unit of AC 23 duty or MCCB as per SLD.
- Mechanical ON/OFF indication
- Door interlock ,defeat interlock and padlocking facility.
- Rating 32/63/100/125/250/400 A as specified / as per SLD.

Type 'D' (Spare Feeders)

- Each PMCC shall be provided with atleast 20% spare feeders or minimum of 1 no. of spare feeder of each rating whichever is maximum.

Type 'F' (Capacitor Feeders)

- Heavy duty fuse switch unit of AC 23 duty
- Mechanical ON/OFF indication
- Door interlock, defeat interlock and padlocking facility.
- Rating 32/63/125/250 A as specified / as per SLD.
- APFC relay for PF correction.
- Capacitor Bank as per SLD
- PF meter with lagging and leading indication

6.0

Special tools

A set of special tools required for the normal operation and maintenance shall be supplied with each PDB. The tenderer shall include, along with each PMCC, one height adjustable circuit breaker trolley for removal and replacement of the withdrawable circuit breaker carriage.

7.0

Painting

All sheet metal work shall undergo a process of

- Degreasing



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- Pickling in acid
- Cold rinsing & Phosphating
- Two primer coats of Epoxy based primer suitable for corrosive (seashore) atmosphere.
- Two finish coats of painting of light grey or approved colour shade and quality.
- The interior of panel shall have eggshell white paint.

8.0 Inspection & testing

The owner or his authorized representatives may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.

The contractor shall submit Quality Assurance Plan (QAP) for respective equipments within three weeks of award of contract. Owner's representative shall be given minimum two weeks advance notice for witnessing the final testing.

Inspection and testing of equipment shall be carried out by the owner/ consultant at the works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approved drawings and reference national/ international standards.

QAP shall be prepared and furnished by the contractor in PMC Form No.11.20 (4.4) F- 10. Test certificates including test records and performance data etc. shall be furnished by the vendor.

Inspection will be carried out on the basis of the purchaser's drawings/ manufacturer's approved drawings and instructions contained in the QAP.

QAP shall generally cover the following tests:

- Visual
- Dimensional
- Fitment & alignment
- Measurement of IR Value – Before HV test & after HV test
- High voltage test/ dielectric test
- Routine test as per relevant IS/other standard
- Type test as per relevant IS/other standard
- Test certificates of bought out items
- Paint shade verification
- Operational & functional check
- Verification of BOM

Tests at works and tests at site shall include the following:

- a. One minute PF withstand voltage between phases, phase to earth and between open poles as well as for the auxiliary/control circuit.
- b. Insulation resistance test for power, auxiliary and control circuits.
- c. Milli volts drop across incoming and outgoing jumper connections with breaker closed and in service position.
- d. Physical inspection



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- e. Operational tests
- f. Temperature rise test on main and vertical busbars
- g. Tests to prove inter changeability of breakers with same current rating.
- h. Calibration of meters (if supplier is to commission the equipment, this can be done at site)
- i. Check of control circuits
- j. Test to prove operating voltage range of spring charging motor, closing coil, trip coil and relays.
- k. Heat run test

10.0 Drawings

The following drawings shall be submitted for approval as per agreed schedule.

- a) Dimensional GA drawing of PDB indicating busbar arrangement, foundation details, gland plate location, Front view of PDB indicating component locations.
- b) Single line schematic diagram indicating feeder details.
- c) Control schemes of feeders.
- d) Component specification details.
- e) List of inscriptions.
- f) Internal wiring diagrams
- g) Terminal plan and external connection diagrams.
- h) Cross sectional drawings of cubicle indicating details of busbar chamber, cable chamber, breaker chamber etc.
- i) Catalogues of relays, breakers.
- j) Operation and Maintenance Manual
 - Recommended procedure for routine maintenance
 - Tests for checking of proper functioning
 - Diagnostic trouble shooting/ fault location charts
- k) Storage, conservation and re-commissioning Manual
- l) Safety Manual
- m) List of special tools and tackles

11.0 PACKING

The equipment shall be properly packed. Special notations such as fragile, this side up, centre of gravity, etc. shall be clearly marked on the package.

12.0 COMPLETENESS OF EQUIPMENT

All fittings, accessories or apparatus which may not have been specially mentioned in this specification but which are otherwise necessary for satisfactory working of PDB shall be deemed to have been included in the scope of supply.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
LIGHTING FIXTURES OF HAZARDOUS AREAS**

SPECIFICATION NO. –



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

CONTENTS

SL.NO.	DESCRIPTION
1.0	SCOPE
2.0	CODES & STANDARD
3.0	ENVIROMENTAL CONDITION
4.0	DESIGN REQUIREMENT
5.0	GENERAL REQUIREMENTS
6.0	COMPLETENESS OF EQUIPMENTS
7.0	DRAWING AND DOCUMENTS
8.0	INSPECTION



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 SCOPE

This specification defines the design, construction, testing and supply of lighting fixtures suitable for installation in classified hazardous locations in Refineries/Petrochemical plants. Unless specified in material requisition all fixtures shall be suitable for Zone-1 & Zone-2 & Gas Groups IIA & IIB as per IS 2148.

1.1.1 Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:

Type of Hazardous areas, its zone protection grade and gas group classification for suitability of installation of adequate flameproof light fittings.

Type of Light fittings and its quantities in line with SOR.

Conventional type HPMV Well glass luminaire/ industrial grade LED flameproof luminaire

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 CODES & STANDARDS

2.1 The design, manufacture and performance of equipment covered by this specification shall conform to the relevant Indian / International standards and Codes. In particular, the equipment offered shall conform to the latest revision of the following standards.

IS:1913	:	Electric lighting fittings, general and safety requirements for Luminaries:Tubular fluorescent lamps
IS:2148	:	Specification for flameproof enclosures
IS:2206	:	Flameproof electrical lighting fittings Point I & II (well glass and bulk head type, fittings using glass tubes)
IS:5572	:	Classification of hazardous area for electrical installation
IS:6381	:	Construction and testing of electrical apparatus with type of protection 'e'
IS:8224	:	Electric lighting fitting for division 2 areas
IS:8289	:	Electrical equipment with type of protection 'n'



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

IS:10322

Luminaires – Part – 1 – General Requirements

Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

2.2 In case any contradiction between various referred standards/specification/data sheets and statutory regulation etc the following order of priority shall be govern -

- i) Schedule of rates
- ii) Design Basis
- iii) Scope of work/Job specification
- iv) Data Sheet
- v) Standard specification
- vi) Codes & standard

3.0 ENVIRONMENTAL CONDITIONS

The Lighting fixtures shall be designed for continuous operation under the climatic and environmental conditions as described in the “Design Basis-Electrical/Scope of Work”.

4.0 POWER SUPPLY SYSTEM

Unless until specified in material requisition all lighting fixtures shall be suitable for 220 - 250 volts single phase neutral & 50 Hz power supply.

5.0 DESIGN REQUIREMENTS

Light fittings for use in Hazardous areas have the following characteristics. They are sealed to prevent the ingress of the liquid, gas or dust, lens for lamp, protection of a robust impact resistant material. They have a seal or machined face to ensure resistance to liquid, dust or gas, or a quenching flame path. Light fittings have different grades of protection depending on their construction and intended purpose. Some fittings are classified according to their IP Ingress Protection rating as it is designated.

When Light fittings and other electrical apparatus are to be installed in a Hazardous Area it is essential that the decision maker takes measures to reduce the likelihood of an explosion by the correct selection of the equipment to be installed in that area. As the gases and vapours liable to be present are rated according to ignition temperature, Flash point and lower explosive limit, this information must be on hand when making your light fitting selection.

All flame proof fixtures and accessories shall be tested and certified by CMRI/CCE or independent authorities of country of origin for use in specified gas group location/Hazardous area. Certification number/data and gas group/temperature classification must be indicated on the manufacturer's nameplate on each fixture. Contactor shall furnish the type test data & certificates of approval of fixture for use for hazardous location along with offer.

All lighting Fixtures shall conform to the latest revision of all relevant Indian / International Standards / IS / BS / DIN etc. and statutory requirements of Govt. of India and Indian Electricity Act and statutory



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

requirements of Govt. of Jharkhand, Safety codes & technical rules / norms.

Lighting Fixtures shall be properly packed to avoid any damage during transit. The Luminaries under the scope of supply shall be capable of functioning normally under voltage and frequency fluctuations specified in this specification.

Replacement of damaged lighting fixtures including lamps, ballast etc. during transit shall be done immediately.

Replacement of defective lighting fixtures including lamps/ ballast etc. shall be done immediately.

Energy saving features shall be provided along with the fixtures.

6.0 GENERAL REQUIREMENT

6.1 Construction

All fixtures shall be suitable for use in outdoor open location and shall have degree of protection IP-65 or above.

The body of the lighting fixture shall be of cast aluminium alloy LM-6 and should be free from frictional sparking hazard. Complete fixture body and accessories shall be suitable to withstand corrosive atmosphere. Outer metallic surface shall be treated/ prepared and provided with two coats of epoxy paint. All screws, nuts, studs, clamps, supporting brackets, etc. shall be electro galvanized or zinc passivated.

All fixtures shall be provided with sheet steel vitreous enamelled or approved type of reflector. Glass used for fixtures shall be clean, heat & impact resistant and toughened type suitable for use under conditions involving exceptional risk of mechanical damage and shall be type 'A' as per IS 2206 or the requirements stipulated by international standards. All well glass fixtures shall be provided with steel wire protecting cage having mesh dimension not exceeding 50 mm.

The fixing parts of the enclosure which is to be opened for replacement of bulb shall be so fastened that they can only be unfastened with special tools. All fixtures shall carry a special warning inscription in English to "Isolate supply elsewhere before opening". Three sets of special tools required for maintenance of fixtures shall be supplied free of cost along with the fixtures.

The temperature rise of external surface shall not exceed the temperature specified in the standards for the gas group to which fitting shall be suitable.

All junction boxes for looping for SPN Lighting circuits using cables upto 4 mm² shall be minimum 100 mm dia in size. Junction boxes for looping of large three phase cable and multiple single phase circuits shall be of minimum 300x250x100 mm. in dimension complete with flameproof cable glands as specified in material requisition.

The top of all well glass lighting fixtures shall be identically drilled/ threaded to facilitate the installation on pole/column or ceiling as per the enclosed sketch using stud/bracket supplied by others.

6.2 FLAME PROOF FITTINGS



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Flame proof type fittings will be well glass type luminaries suitable for use with HPMV 80W/ 150W/ 250W/400W (High pressure Mercury Vapour) lamp to be used in gas group IIA/IIB and Zone-1/2 with separate control gear complete with copper ballast, power factor improvement capacitor, terminal block enabling loop-in-loop out connection. Fixture and lamp shall be perfectly matched and from same manufacturer. The fittings shall be supplied complete with all mounting accessories etc. The fitting shall be heavy duty and conform to IP 65 degree of protection

The control gear box and enclosure for fittings will have certification from CMRS, Dhanbad and will be suitable for gas groups IIA & IIB as per IS 2148-1981. The fittings will be designed as per IS 2206 (Part-I) - 1987. The material for cable gland will be brass/stainless steel/aluminium alloy LM6 and will be double compression type suitable for indoor/outdoor use. These are must for every flameproof fittings and accessories.

Alternatively, LED flameproof well glass luminaire of 30W/ 40W (in place of 70W/125W HPMV) / 60W (in place of 250W HPMV) / 90W (in place of 400W HPMV), recommended for illuminating hazardous area laden with gases or vapors of group IIA, IIB & IIC & zone 1 & 2, suitable for industrial lighting may also be used as per manufacturer's standards. It shall have High pressure die cast aluminum housing with housing with toughened clear heat resistance well glass is cemented into a retaining ring which is fixed with screws to the main housing and the High power COB/SMD LEDs shall have luminous efficacy greater than 140 lm/W. It shall consist of highly reliable constant current LED driver. The LEDs shall withstand minimum surge protection of 4KV. The fitting shall be heavy duty and conform to IP 66 degree of protection.

7.0 COMPLETENESS OF EQUIPMENT

All fittings, accessories or apparatus which may not have been specially mentioned in this specification but which are otherwise necessary for satisfactory working of installation & working of lighting fixtures shall be deemed to have been included in the scope of supply.

8.0 DRAWINGS & DOCUMENTS

Documents to be submitted along with the bid/offer:

- Confirmation of scope of supply. All pages of NIT to be signed.
- Un-priced copy to be submitted stating "quoted" against each item.
- Latest Catalogue.

Following drawings/ documents/ data shall be submitted for approval by the tenderer:

- Lighting Fixture Data sheets.
- GA of fixtures including mounting arrangement (Ceiling / wall/ structure / Pole).
- Bill of Materials (BOM).
- Product Catalogue.

9.0 TESTING AND INSPECTION

After completion of manufacturing of Lighting Fixtures and prior to despatch, the Lighting Fixtures shall be subjected to type, routine, acceptance and special tests as per the approved QAP. Purchaser / Consultant reserve the right to witness all tests with sufficient advance notice from vendor.

Inspection call shall be given by the manufacturer for association of purchaser or his representative during inspection. Inspection call shall be given minimum 15 days in advance from the proposed date of inspection. Four sets of relevant manufacturer test certificates, test certificate for major bought out components, internal inspection report of tenderer (if applicable) etc. as per the approved QAP shall be enclosed with each inspection call.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Inspection and testing of equipment shall be carried out by the owner/ consultant at the works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approval draws, and reference national/ international standards.

The contractor shall submit Quality Assurance Plan (QAP) for respective equipments within 3 weeks of award of contract.

QAP shall be prepared and furnished by the contractor in PMC Form No. 11.20(4.4) F-10 along with their internal in process quality checks.

Routine test and type test certificate shall be furnished for review.

The following type tests shall be carried out as per applicable Indian Standards and shall form part of acceptance testing

- a) Dimensional check up
- b) Static hydraulic test
- c) Impact test
- d) Thermal shock test
- e) Durability test
- f) Test for temperature rise
- g) Test for flameproofness

Acceptance test shall be witnessed by owner/consultant.

The following tests shall constitute acceptance tests:

- a) Dimensional check up
- b) Static hydraulic test
- c) Impact test
- d) Thermal shock test
- e) Durability test

The following tests shall constitute routine tests:

- a) Dimensional check up
- b) Static hydraulic test

10.0 PACKING / PROTECTIVE SHIPPING & DELIVERY:

10.1 Packing And Forwarding:

All items shall be covered with water proof plastic packages and then packed in wooden crates. Dehumidifying agents shall be put inside the packing. All heavy items like control panels, etc. shall be properly supported by wooden structures before dispatch to avoid any damage during transit and handling of the packages. Electrical equipment shall be delivered to the consignee site by road transport Lorry receipt, invoices, packing list, etc. shall be sent to the consignee along with dispatch of equipment.

10.2 Match Marking:

The sub-assemblies/parts shall be properly match marked before dismantling for packing and dispatch. Manufacturer for reference during erection at site shall submit match-marking drawings to the purchaser.



Bhagyanagar Gas Ltd.
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**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SPECIFICATION FOR
CAPACITOR BANK**

SPECIFICATION NO.-



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

CONTENTS

SL. NO.	DESCRIPTION
1.0	INTENT
2.0	CODES & STANDARDS
3.0	TECHNICAL REQUIREMENTS
4.0	DRAWINGS AND DOCUMENTS
5.0	INSPECTION & TESTING
6.0	CAPACITOR SIZING CALCULATION



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1.0 INTENT

- a) The intent of this standard specification is to define the general requirements for design, manufacture, assembly and testing at manufacturer's works, packing, transportation and receipt at site with all materials and accessories of Capacitor Bank.
- b) **Tenderer to refer separate Technical specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:**
1. **Requirement of Capacitor bank and its rating & voltage level.**
 2. **Number of Steps/Switching Conditions/ Capacitor Units and its corresponding ratings.**
 3. **Incoming feeder rating/ switchgear details etc. or other project specific details, if any.**

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2.0 CODES & STANDARDS

The Capacitor bank shall comply with the latest edition of the following and other relevant Indian standards. In case equipment is supplied by foreign manufacturers relevant international standards shall be applicable.

IS: 2834:1986	-	Specification for Shunt Capacitors for power systems.
IS – 13340: 2012	-	Specification for Shunt Power Capacitors of Self- healing type for AC Systems upto rated voltage of 1100V
IS: -13925:2012	-	Specification of Shunt Capacitors for AC power systems for Voltages above 1000V



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

IEEE - Recommended practice for electrical power distribution (Std. 141) for industrial plants.

3.0 TECHNICAL FEATURES

AUTOMATIC POWER FACTOR CORRECTION EQUIPMENT

The capacitor banks rating shall be selected in such a way so that the power factor shall be maintained to 0.95 or higher at 415 V at all load conditions.

The actual rating of the capacitor bank shall be finalised during drawing approval stage and it shall be provided without any price variation. The rating of the capacitor feeding cables shall be 30% higher than the normal rating

The capacitor bank shall be sheet steel enclosed, free standing, dust & vermin proof and suitable for indoor service. The banks shall be complete with capacitors, busbars chamber and busbars, suitable discharge resistor and fuse for individual capacitor, arrangement for cable entry and termination, earthing terminal, nameplate etc.

The control panel shall be complete with all relays, contactors, switches, lamps etc. Both manual and automatic correction shall be provided. The panel shall be sheet steel enclosed, free standing, dust & vermin proof and suitable for indoor service. The panel shall be complete with busbars chamber and busbars and arrangement for cable entry and termination, earthing terminal, nameplate etc.

The minimum voltage rating of capacitors shall be 460V (phase to phase). CFS unit and contactors shall be suitable for capacitor switching duty. Capacitor shall have higher voltage rating to account for series reactor and 10% system over voltage.

LT capacitors shall be controlled by contactors. The total bank isolation, from the MCC bus, shall be achieved by suitably rated CFS unit having capacitor switching capability. Current rating of CFS unit shall be 30% higher than the normal rating of capacitor bank.

Capacitor bank shall have generally use of different capacity ratings such as of 12.5KVAR , 25KVAR , 50 KVAR , 100 KVAR and so on , that shall be used such that control of desired power factor by proper selection of capacitor rating switching requirements can be more accurately achieved.

Each capacitor bank shall be of 3 Nos. of each individual capacitor rating units connected in delta & should have external fuses for protection. Each capacitor feeder shall have under voltage and over voltage protection by using relay.

Each capacitor shall have series reactor/ choke inductance to control the inrush current. The tenderer shall furnish the rating of capacitor bank and the series reactor/ choke inductance along with calculations in the offer based on data indicated in SLD.

Necessary CT requirement for automatic power factor correction in the incomer breaker panel shall be provided for automatic intelligent power factor controller. Automatic measurement system of the running



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

load / power factor shall be provided to calculate the desired capacitor bank loading through use of automatic correction / capacitor bank switching command.

3.1 Capacitor units


Each capacitor unit shall be fully enclosed in sheet steel on plastic container of adequate thickness suitable for mounting inside the capacitor cubicle. The unit shall be supplied with necessary accessories for forming bank of specified rating.

Capacitors shall be of polypropylene dielectric with self-healing properties. Each unit shall have built-in discharge resistor, series reactor and unit protection fuses and two terminal bushings. The fuses shall not deteriorate or operate due to repeated switching at rated voltage.

The minimum voltage rating of capacitors shall be 440V (phase to phase). Capacitor shall have higher voltage rating to account for series reactor and 10% system over voltage.

The unit shall conform to IS-2834-1981 / IS-13925 and shall be suitable for an ambient of 50 degrees C.

PARAMETER	SPECIFICATION
Rated voltage	- 460V AC
Rated frequency	- 50 Hz
Max. over-current	- 1.3 times rated current
Max. over-voltage	- 1.1 times rated voltage
Max. over load	- 1.3 times rated output
Fuse (capacitor unit)	-External fuse connected before capacitor


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Mounting	- IP54 enclosure mounted in a panel / box
Discharge device	- Directly connected discharge device across the capacitor (in the same enclosure) to limit the residual voltage
Connection	- By PVC copper / Aluminium cable suitable for bottom entry
Earth connection	- Distinct earth terminals clearly marked . Specify terminal size
Bank connection	- Delta connected
Max. permissible withstand capacity	- As per IS13340
Peak inrush current	- As per IS13340
Over voltage / long duration voltage withstand capacity	- As per IS13340
Temperature class	- Suitable for 45 deg C ambient (as per IS 2834). - Specify class selected.
Capacitance tolerance	- Pl specify
Terminals	- Specify size with cable gland details
Bushing type	- Pl specify
Insulation level	- 2.5 KV

3.2 Capacitor banks

Each LT switchboard section shall have specified number and rating of capacitor banks. The capacitor banks shall be delta connected using singlephase units rated for 440 V. Where capacitor banks of different ratings are specified, the same shall be built-up from a single standard capacitor unit. The capacitor bank formation inside the cubicle shall be formed considering easy accessibility for each unit and better air clearances. All bus work shall be adequately supported for maximum fault level specified.

Each bank shall be independently controlled. All the banks shall be controlled automatically based on bus power factor. The control scheme shall be such that

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------


maximum number of steps are achieved for smooth control of power factor.

- 3.3 Control equipment:** Each capacitor bank shall have independent control equipment comprising fuse switch unit, power contactor with auxiliary contacts, line CTs with taut band ammeter and selector switch to read phase currents of capacitor bank feeder, ON/OFF indicating lamps, auto/manual selector switch, auxiliary relays and any other equipment required for satisfactory operation, maintenance and control. Local/remote selector switches where specified shall be provided for switching ON/OFF capacitor banks from remote location. Each bus section shall have a multistage (12 stage) microprocessor based PF relay with associated contactors, bus PF meter for group control of the banks connected to respective bus section. The power factor controller shall have LCD display with indication of inductive/capacitive power factor, active outputs, demand for switching on/off of a capacitor step, alarm conditions, overtemperature conditions, phase shift, C/K ratio, type of switching sequence etc. It shall also have optional RS-485 Modbus adaptor for allowing communication with a monitoring system.

All switching equipment shall have capacitor switching rating of 150% of rated current of capacitor bank. All equipment shall be suitable for 240 V AC control supply. Necessary protection through HRC fuses shall be provided for control circuits. Control supply shall be drawn preferably through control transformer. Necessary interlock shall be provided to ensure switching-on of capacitor banks after it is fully discharged.

3.4 Details to be furnished in datasheet of APFC Panel:

- i) Name of manufacturer
- ii) kVAR rating
- iii) Rated voltage
- iv) Rated Frequency
- v) Number of phases
- vi) Type of connection
- vii) Enclosure details
- viii) Material of construction and its thickness
- ix) Dimensions
- x) IP Protection class
- xi) Application
- xii) Cable entry details
- xiii) Paint shade
- xiv) Busbar details – Material, cross section, busbar supports etc.
- xv) Capacitor type
- xvi) Number of steps
- xvii) Configuration details
- xviii) Switchgear details – Incomers, outgoing, APFC Relays etc.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

xix) Bill of material

4.0 DRAWINGS AND DOCUMENTS

4.1 Vendor shall furnish all data/drawings/documents specified in the vendor data requirement. Approval of the drawing shall not relieve the manufacturer of his responsibility to equipment conforming to the relevant specification and standards or for any mistakes, errors or omissions in the drawing.


4.2 Following Drawings & Documents shall be submitted after award of contract for approval:

- i) List of drawings
 - a) Overall General arrangement drawing
 - b) Capacitor bank details
 - c) Capacitor sizing calculation
 - d) Technical Datasheet
 - e) Bill of material
 - f) QAP, Internal Test Certificates and Inspection Certificates
- ii) Instruction manuals for erection, testing and commissioning.
 - a) Instruction manual shall give step by step procedure for:
 - Erection, testing and commissioning
 - Operation
 - Maintenance and
 - Repair
 - b) Operation and Maintenance Manual
 - Recommended procedure for routine maintenance
 - Tests for checking of proper functioning
- iii) List of special tools and tackles

5.0 TESTS AND ACCEPTANCE

Tests shall be carried out at manufacturer's works under his care and expense.

The manufacturer shall submit a QAP inline with the format enclosed for approval of PMC. All tests and documents of inspection documents shall be

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

shall be done based on this.

All routine tests as specified by the applicable standard code shall be conducted. Type test certificates for the Capacitor bank from a recognized testing organization shall be furnished with the bids. The vendor shall also submit a list of guaranteed technical particulars with the bids.

In addition, specific tests shall be conducted to check mechanical and electrical operation/wiring etc. and panel wiring conforming to the specification and approved schematic drawings.

All routine tests on capacitor banks shall be conducted as per relevant standards (Refer IS: 13118 – latest revision).


Above tests shall be provisionally conducted at manufacturer's works by providing temporary connection to switchgear units in order to simulate the actual conditions.

QAP shall generally cover the following tests:

- Visual
- Dimensional
- Fitment & alignment
- Measurement of IR Value – Before HV test & after HV test
- High voltage test/ dielectric test
- Routine test as per relevant IS/other standard
- Type test as per relevant IS/other standard
- Impulse test HT
- Test certificates of bought out items
- Paint shade verification
- Operational & functional check
- Verification of BOM

Type tests:

- Thermal stability test
- Measurement of the tangent of the loss angle ($\tan \delta$) of the capacitor at elevated temperature
- Voltage test between terminals
- Voltage test between terminals and container
- Lightning impulse voltage test between terminals and container
- Discharge test
- Ageing test
- Self-healing test
- Destruction test

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Routine tests:

- Capacitance measurement and output calculation
- Measurement of the tangent of the loss angle ($\tan \delta$) of the capacitor at elevated temperature
- Voltage test between terminals
- Voltage test between terminals and container
- Test of the internal discharge device
- Self-healing test

All the capacitor banks shall be subjected to the routine tests as per IS 13340 at manufacturer's works. Type test certificates for similar design have to be submitted for approval. Test procedures as specified in IS-13340 shall be adopted.

6.0 CAPACITOR SIZING CALCULATION (To be submitted by the vendor)

- i) Required kVAr = kW [$\tan \cos^{-1}(\text{initial pf}) - \tan \cos^{-1}(\text{final pf})$]
- ii) kVAr of capacitor bank = $\frac{2 \times \pi \times f \times C}{100}$
- iii) kVAr of series reactor = kVAr of capacitor bank x % of reactor
- iv) Current of series reactor = $\frac{\text{kVAr of capacitor bank}}{\text{kV} \times \sqrt{3}}$
- v) Inrush current = $\frac{U \sqrt{2}}{\sqrt{X_C \times X_L}}$



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SECTION-9
SPECIAL CONDITIONS OF CONTRACT
(SCC)**



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SPECIAL CONDITIONS OF CONTRACT

- 1.0 GENERAL
- 2.0 SCOPE OF WORK & SCOPE OF SUPPLY
- 3.0 SUPPLY OF WATER, POWER & OTHER UTILITIES
- 4.0 TIME OF COMPLETION
- 5.0 DRAWINGS AND DOCUMENTS
- 6.0 COMPLIANCE WITH LAWS
- 7.0 GOVERNMENT OF INDIA NOT LIABLE
- 8.0 REGISTRATION OF THE CONTRACT WITH STATUTORY AUTHORITIES
(FOR FOREIGN BIDDER)
- 9.0 LIMITATION OF LIABILITY
- 10.0 CRITICAL WORK TO BE CARRIED OUT BY CONSORTIUM LEADER-
DELETED
- 11.0 CONTRACT PERFORMANCE GUARANTEE
- 12.0 TAXES, DUTIES AND LEVIES IN INDIA
- 13.0 TAXES, DUTIES AND LEVIES IN FOREIGN COUNTRIES
- 14.0 SUBSEQUENT LEGISLATION
- 15.0 STATUTORY VARIATION IN TAXES & DUTIES-**DELETED**
- 16.0 INCOME TAX & CORPORATE TAX
- 17.0 CUSTOM DUTY
- 18.0 CUSTOM DUTY ON CONSTRUCTION EQUIPMENTS
- 19.0 ISSUE OF ESSENTIALITY CERTIFICATE
- 20.0 IMPORT LICENCE
- 21.0 WITHHOLDING, ACCOUNTING AND TAX REQUIREMENTS
- 22.0 INTELLECTUAL PROPERTY
- 23.0 FIRM PRICE
- 24.0 WORKS CONTRACT
- 25.0 PROVIDENT FUND ACT
- 26.0 **DELETED**
- 27.0 CHANGE ORDERS/ EXTRA WORKS/ DEVIATIONS
- 28.0 CONSTRUCTION RIGHT -OF-USE AND PERMITS - VOID
- 29.0 CONSTRUCTION EQUIPMENT AND ORGANIZATION
- 30.0 MECHANISED CONSTRUCTION
- 31.0 GENERAL GUIDELINES DURING AND BEFORE ERECTION
- 32.0 **DELETED**
- 33.0 MEASUREMENT OF WORKS
- 34.0 TERMS OF PAYMENT
- 35.0 **DELETED**
- 36.0 ISSUE OF OWNER/EIC SUPPLIED MATERIAL
- 37.0 LOCATION OF DUMPYARD/ WAREHOUSE/ STORAGE YARD
- 38.0 STATUTORY APPROVALS
- 39.0 TESTS AND INSPECTION
- 40.0 INSPECTION OF SUPPLY ITEMS
- 41.0 FINAL INSPECTION



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- 42.0 COMPENSATION FOR EXTENDED STAY
- 43.0 COMPUTERIZED CONTRACTORS BILLING SYSTEM
- 44.0 TEMPORARY WORKS
- 45.0 DISTINCTION BETWEEN FOUNDATION AND SUPERSTRUCTURE
- 46.0 QUALITY ASSURANCE/ QUALITY CONTROL
- 47.0 HEALTH SAFETY AND ENVIRONMENT (HSE) MANAGEMENT
- 48.0 SITE CLEANING
- 49.0 COMPLETION DOCUMENTS
- 50.0 COORDINATION WITH OTHER AGENCIES
- 51.0 SETTLEMENT OF DISPUTE BETWEEN TWO **-DELETED**

- 52.0 UNDERGROUND AND OVERHEAD STRUCTURES
- 53.0 TEST CERTIFICATES
- 54.0 ROYALTY
- 55.0 EXCAVATION BY BLASTING **VOID**
- 56.0 SITE FACILITIES FOR WORKMEN
- 57.0 EXECUTION OF ELECTRICAL WORKS
- 58.0 HYDROSTATIC TESTING
- 59.0 ARBITRATION
- 60.0 MAKE OF MATERIALS
- 61.0 ADDITIONAL WORKS/ EXTRA WORKS
- 62.0 COMPENSATION FOR DELAY/PRICE REDUCTION SCHEDULE FOR ANY DELAY

- 63.0 PROJECT PLANNING, SCHEDULING AND MONITORING SYSTEM
- 64.0 RESPONSIBILITY OF CONTRACTOR
- 65.0 CHECKING OF LEVELS
- 66.0 STORAGE FACILITIES
- 67.0 ABNORMALLY HIGH RATED ITEMS (AHR ITEMS)
- 68.0 INSURANCE FOR FREE ISSUE MATERIAL
- 69.0 INSURANCES IN INDIA
- 70.0 INSURANCE IN FOREIGN COUNTRIES
- 71.0 BANK GUARANTEES
- 72.0 SUBMISSION OF COLOURED PHOTOGRAPHS
- 73.0 DISPOSAL OF EMPTY OFC CABLE DRUM
- 74.0 VIDEO RECORDING & PHOTOGRAPHS
- 75.0 SINGLE POINT RESPONSIBILITY
- 76.0 SPARES
- 77.0 BUILDING AND OTHER CONSTRUCTION ACT
- 78.0 BONUS FOR EARLY COMPLETION
- 79.0 REQUIREMENT OF EMPLOYMENT VISA FOR FOREIGN NATIONALS
- 80.0 REQUIREMENT OF PAN FOR FOREIGN BIDDER
- 81.0 STATUTORY COMPLIANCE UNDER LABOUR AND INDUSTRIAL LAWS
- 82.0 DIRECT PAYMENTS TO SUB-VENDORS/ SUPPORTING AGENCIES OF MAIN CONTRACTOR

- 83.0 SUB-LETTING OF WORKS
- 84.0 WAY BILL / ROAD PERMIT
- 85.0 JOINTS MEASUREMENT OF WORK EXECUTED, BILLING, INVOICE AND




Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II


PAYMENTS

- 86.0 OPPORTUNITY OF EMPLOYMENT TO THE PEOPLE, BELONGING TO SCHEDULED CASTES AND WEAKER SECTIONS OF THE SOCIETY
- 87.0 COMPLETION CERTIFICATE
- 88.0 PRADHAN MANTRI SURAKSHA BIMA YOJANA (PMSBY) AND PRADHAN MANTRI JEEVAN JYOTI BIMA YOJANA (PMJJBY)
- 89.0 ANNUAL RATE CONTRACT CONDITIONS
- 90.0 PLANNING AND DESIGNING IN PURVIEW OF VULNERABILITY ATLAS OF INDIA
- 91.0 PLANT, MACHINERY & SHUTTERING MATERIAL ADVANCE
- 92.0 SECURED ADVANCE AGAINST MATERIAL BROUGHT AT SITE.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

1.0 GENERAL

- 1.1 Special Conditions of Contract shall be read in Conjunction with the General Conations of Contract, specification of work, Drawings and any other documents forming part of this contract wherever so required.
- 1.2 Notwithstanding the sub-division of the documents into these separate sections and volumes, even part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into contract so far as it may be practicable to do so.
- 1.3 Where any portion of the General Conditions of Contract is repugnant to or at variance with any provision of the Special Conditions of Contract, unless a different intention appears, the provisions of the Special Conditions of Contract shall be deemed to over- ride the provisions of the General Conditions of Contract and shall to the extent of such repugnancy, or variations, prevail.
- 1.4 Wherever it is mentioned in the specifications that the CONTRACTOR shall perform certain work or provide certain facilities, it is understood that the CONTRACTOR shall do so at this cost and the value of contract shall be deemed to have included cost of such performance and provision, so mentioned.
- 1.5 The material, design and workmanship shall satisfy the relevant INDIAN STANDARDS, the JOB SPECIFICATION contained herein and CODES referred to. Where the job specification stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.
- 1.6 In case of an irreconcilable conflict between Indian or other applicable standards General Conditions of Contract, special Conditions of Contract, Specifications, Drawings or Schedule of Rates, the following shall prevail to the extent of such irreconcilable conflict in order of precedence:
 - i) Contract Agreement
 - ii) Detailed Letter of acceptance along with statement of Agreed variations.
 - iii) Fax / Letter of Intent / Fax of Acceptance
 - iv) Schedule of Rates as enclosures to letter of acceptance
 - v) Job / Particular Specifications
 - vi) Drawings
 - vii) Technical / Material Specifications
 - viii) Special Conditions of Contract
 - ix) Instructions to Bidders (ITB)
 - x) General Conditions of Contract
 - xi) Indian Standards
 - xii) Other Applicable Standards

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

1.7 It will be the contractor's responsibility to bring to the notice of owner/ engineer in charge (EIC) any irreconcilable conflict in the contract documents before starting the work(s) or making the supply with reference which the conflict exists.

1.8 In the absence of any specification covering any material, design of work(s) the same shall be performed/ supplied/ executed in accordance standards engineering practice as per the instructions/ directions of the Owner/Engineer in charge which will be binding on the CONTRACTOR.

2.0 SCOPE OF WORK & SCOPE OF SUPPLY

The scope of work covered in this Contract will be as described in Annexure-1, Particular Job Specifications, Standard Specifications, and Schedule of Rates etc. The scope of supply covered in this Contract will be as described in Annexure-2, Particular Job Specifications, Standard Specifications, and Schedule of Rates etc. It is however, explicitly understood that scope described is not limiting, in so far as the responsibilities of the contractor are concerned and shall include, inter-alia, carrying out any and all works and providing any and all facilities as are required to complete the works in all respect.

3.0 SUPPLY OF WATER, POWER & OTHER UTILITIES


3.1 The Clause No. 2.3 to 2.5 given in General Conditions of Contract is modified to following extent:

3.2 The Contractor shall be responsible at his own cost for arranging and providing all the required Water, Power, land required for temporary site office, fabrication yard and other utilities, in the quantities and at the times required for performance of work under the contract. The contract price shall be deemed to include all costs towards the same.

The Owner/ EIC shall not supply water, power and other utilities.

3.3 Contractor shall, if required by him, for the entire duration of the execution of the work make available near the site, land for constructions of contractors' office, office, Warehouse, Workshops and for any purpose in connection with providing infrastructure required for the execution of the Contract. The Contractor shall at his own cost construct all temporary buildings and provide suitable water supply and sanitary arrangement as required. On completion of the work undertaken by the Contractor, he shall remove all temporary works erected by him and have the site cleared as directed by Engineer-in-Charge. If the Contractor shall fail to comply with these requirements, the Engineer-in-Charge may at the expense of the Contractor remove such surplus and rubbish materials and dispose off the same as he deems fit and get the site cleared as aforesaid, and the Contractor shall forthwith pay the amount of all expenses so incurred and shall have no claims in respect of any such surplus material disposed of as aforesaid.

3.4 Cutting of trees shall not be permitted except in the case that tree is falling on the line of ROU/ROW. In such circumstances, details of such tree being cut shall be

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------


prepared and forest/ municipal authorities be informed and necessary approval be obtained by contractor. However, after backfilling of trench & restoration, contractor should plant equal number of saplings in that area. Cutting of trees for any purposes (fuel etc.) by workers is strictly prohibited.

4.0 TIME OF COMPLETION

- 4.1 The work shall be executed strictly as per Time schedule given in Annexure-3 in the bidding document. The period of completion given includes the time required for mobilization [15 (fifteen) days] as well as testing, rectifications, if any, retesting and completion in all respects to the entire satisfaction of the Engineer-in-Charge.
- 4.2 A joint programme of execution of work will be prepared by the Engineer-in-Charge and Contractor. This programme will take into account the time of completion mentioned above.
- 4.3 Monthly/ weekly construction programme will be drawn up by Engineer-in-Charge jointly with the contractor based on availability of work fronts and the joint construction programme as above clause. The Contractor shall scrupulously adhere to these Targets/ Programme by deploying adequate personnel, construction tools & tackles and he shall also supply himself all materials of his scope of supply in good time to achieve the targets set out in the weekly and monthly programme. In all matters concerning the extent of targets set out in the weekly and achievements, the decision of the Engineer- in-Charge shall be final and binding on the contractor.
- 4.4 If the Contractor fails to achieve the targeted progress schedule of each month as mentioned in the bidding document, the owner/ EIC at its opinion may terminate the contract as contractors default and get the work completed from other sources at contractors risk and cost.
- 4.5 Contractor shall give every day report on category wise labour and equipment deployed along with the progress of work done on previous day in the Performa prescribed by the Engineer-in-Charge.
- 4.6 The contractor shall submit fortnightly report covering all major activities indicating schedule / actual progress, slippages & its reasons and catch-up plan.

5.0 DRAWINGS AND DOCUMENTS

- 5.1 The drawings accompanying the bid document (if any) are of indicative nature and issued for bidding purpose only. Purpose of these drawing is to enable the bidder to make an offer in line with the requirements of the OWNER/EIC. However, no extra claim whatsoever, shall be entertained for variation in the "Approved for Construction" and "Bid document drawings" regarding any changes/units. Construction shall be as per drawings/specifications issued /approved by the Engineer- in-Charge during the course of execution of work. Detailed construction

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

drawings (wherever required) on the basis of which actual execution of work is to proceed will be prepared by the contractor.

- 5.2 The drawings and documents to be submitted by the Contractor to OWNER/EIC after award of the work as per the requirements enlisted in the bidding document shall be for OWNER/EIC's review, information and record. The Contractor shall ensure that drawings and documents submitted to OWNER/EIC are accompanied by relevant calculations, data as required and essential for review of the document/ drawings. EIC shall review the drawings/ documents within two weeks from the date of submission provided the same are accompanied by relevant calculations, data as required and essential for review.
- 5.3 All documents and drawings including those of Contractors sub-vendor's manufacturers etc. shall be submitted to OWNER/EIC after having been fully vetted in detail, approved and co-opted by the Contractor & shall bear Contractor seal/ certifications to this effect. All documents/drawings & submissions made to OWNER/EIC without compliance to this requirement will not be acceptable and the delay & liability owing to this shall be to the Contractor's account.
- 5.4 The review of documents and drawings by OWNER/EIC shall not absolve Contractor from his responsibility to meet the requirements of specifications, drawings etc. and liabilities for mistakes and deviations. Upon receiving the comments on the drawing/documents reviewed by OWNER/EIC, Contractor shall incorporate the comments as required and ensure their compliance.
- 5.5 copies of all detailed working drawing relating to the works shall be kept at the contractors office at the site and shall be made available to the Engineer-in-charge/ OWNER/EIC at any time during execution in the "approved / issued for construction drawings" and "tender drawings" regarding any changes / units of the contract. However, no extra claim what so ever shall be entertained for any variation unless otherwise agreed.
- 5.6 The Contractor shall rectify any inaccuracies, errors and non-compliance to contractual requirements. Any delay occurring on this shall not construe a reason for delay/ extension.
- 6.0 COMPLIANCE WITH LAWS**
- 6.1 The Contractor shall abide by all applicable rules, regulations, statutes, laws governing the performance of works in India, including but not limited to the following:
- i) Contract Labor (Regulation & Abolition) Act 1970 & the center rules, 1971 framed there under.
 - ii) Payment of Wages Act.
 - iii) Minimum Wages Act.
 - iv) Employer's Liability Act.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- v) Factory Act.
- vi) Apprentices Act.
- vii) Workman's Compensation Act.
- viii) ESI Act, Industrial Dispute Act.
- ix) Environment Protection Act.
- x) Wild life Act.
- xi) Maritime Act.
- xii) Payment of Bonus Act.
- xiii) PNGRB Act
- xiv) Any other Statute, Act, Law as may be applicable.

7.0 GOVERNMENT OF INDIA NOT LIABLE

7.1 It is expressly understood and agreed by and between the Contractor and the OWNER/EIC that the OWNER/EIC is entering into this agreement solely on its own behalf and not on behalf of any other person or entity. In particular, it is expressly understood and agreed that the Government of India is not a party to this agreement and has no liabilities, obligations or rights there under. It is expressly understood and agreed that the OWNER/EIC is an independent legal entity with power and authority to enter into contract, solely in its own behalf under the applicable laws of India and general principal of Contract Law. The Contractor expressly agrees, acknowledges and understands that the OWNER/EIC is not an agent, representative or delegate of Govt. of India. It is further understood and agreed that the Govt. of India is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the contract. Accordingly, contractor hereby expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the Govt. of India arising out of this contract and covenants not to sue to Govt. of India as to any manner, claim, and cause of action or thing whatsoever arising of or under this agreement.

8.0 DELETED


9.0 LIMITATION OF LIABILITY

Add the following at the end of clause no. 80.3 of GCC.

9.1 The final payment by the OWNER/EIC in pursuance of the Contract terms shall not mean release of the Contractor from all of his liabilities under the Contract. The Contractor shall be liable and committed under this contract to fulfill all his liabilities and responsibilities, till the time of release of contract performance guarantee by the OWNER/EIC.

10.0 DELETED

11.0 CONTRACT PERFORMANCE GUARANTEE


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- 11.1 Please refer clause no. 38 of ITB (Vol. I), & Bid Data Sheet (BDS).
- 11.2 In addition to above, following will also apply: -
- a) In the event completion of works is delayed beyond the Scheduled Completion Date for any reasons whatsoever, the Contractor shall have the validity of the guarantee suitably extended to cover the period mentioned above.
 - b) The OWNER/EIC shall have an
Guarantee and claim the amount there under in the event of Contractor failing to honor any of the commitments entered into under this Contract and/or in respect of any amount due from the Contractor to the OWNER/EIC. In case Contractor fails to furnish the requisite Bank Guarantee as stipulated above, then the OWNER/EIC shall have the option to terminate the Notification of Award of Work and forfeit the Bid Security/Earnest Money amount and no compensation for the works performed shall be payable upon such termination.
 - c) Upon completion of the Works as per Completion Schedule stipulated in Contract, the above said guarantee shall be considered to constitute the contractor's warranty / guarantee for the work
done by him or for the Works supplied and performance as per the specifications and any other conditions against this Contract. The warranty/guarantee shall remain in force for 12 months from the date of issuance of certificate of Completion and Acceptance against this Contract as per GCC. Contractor shall also arrange for the Performance Guarantee to remain valid until expiration of the guarantee period for entire works covered under the contract.
 - d) In the event of Completion of Project being delayed beyond the Scheduled Completion Date, the OWNER/EIC may without prejudice to any other right or remedy available to the OWNER/EIC, operate the Bank Guarantee to recover the Compensation for delay levy-able as per Price Reduction

Schedule clause. The Bank Guarantee amount shall thereupon be increased to the original amount, or the Contractor may alternatively submit a fresh Bank Guarantee for the equivalent amount of compensation for delay recovered.

12.0 TAXES, DUTIES AND LEVIES IN INDIA

- 12.1 The Contractor agrees to and does hereby accept full and exclusive liability for the payment of any and all taxes, duties, including GST (Goods and Service Tax), custom duty including applicable cess and GST etc. now in force and hereafter increased, imposed or modified from time to time in respect of works and materials and all contributions and taxes for unemployment compensation, insurance and old age pensions or annuities now or hereafter imposed by any Central or State Government authorities which are imposed with respect to or covered by the wages, salaries, or other compensations paid to the persons employed by the Contractor and the Contractor shall be responsible for the compliance with all obligations and restrictions imposed by the Labor Law or any other law affecting employer- employee relationship and the Contractor further agrees to comply, and

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

to secure the compliance of all sub- contractors with all applicable Central, State, Municipal and local law and regulation, and requirement of any central, State or Local Government agency or authority. Contractor further agrees to defend, indemnify and hold OWNER/EIC harmless from any liability or penalty which may be imposed by the Central, State or Local authorities by reason of any violation by Contractor or Subcontractor of such laws, regulations or requirements and also from all claims, suits or proceedings that may be brought against the OWNER/EIC arising under, growing out of, or by reason of the work provided for by this Contract, by third parties, or by Central or State Government authority or any administrative sub-division thereof. The prices shall also be inclusive of GST (Goods and Service Tax), custom duty including applicable cess and GST and any other tax as applicable. Bidder shall take care of all applicable taxes & duties while submitting their prices.

12.2 OWNER/EIC shall make from Contractors bills such tax deductions as are required as per rules and regulations in force from time to time.

12.3 Any errors of interpretation of applicability of taxes / duties by

12.4 If any tax is applicable during site fabrication, the same must be assessed and deemed to be included by the bidder in the quoted prices. The bidder in this regard shall arrange all required formalities.


12.5 As per Clause 171 of GST Act, it is mandatory to pass on the benefits due to reduction in rate of tax or from input tax credit to the consumer (OWNER) by way of commensurate reduction in prices. The supplier of goods/services may note the above and quote their prices accordingly.

13.0 TAXES, DUTIES AND LEVIES IN FOREIGN COUNTRIES, IF APPLICABLE

13.1 The Contractor agrees to and does hereby accept full and exclusive liability at its own cost for the payment of any and all taxes, duties and levies etc as are payable to any government, local or statutory authority in any country other than India, as are now in force or as hereafter imposed, increased or modified, and as are payable by Contractor, his agents, sub-contractor and their employees etc. for performance of work under this contract. The Contractor shall be deemed to have been fully informed with respect to all such liabilities and considered the same in his bid, and the contract shall not be varied in any way on this account.

14.0 SUBSEQUENT LEGISLATION

14.1 All duties, taxes, fees, charges, expenses, etc. (except where otherwise expressly provided in the Contract) as may be levied/ imposed in consequence of execution of the works or in relation thereto or in connection therewith as per the Acts, Laws, Rules, Regulations in force shall be to Contractor's account. However, any new taxes /duties imposed after the date of submission of last price bid & up to

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Contractual Completion date shall be to shall be to the owners account but such taxes / duties imposed beyond contractual completion date shall be to the contractors account. However, if such new taxes etc. is in substitute of existing taxes, same will be considered on merit of each case.

15.0 **Deleted**

16.0 **Deleted**

17.0 CUSTOM DUTY


17.1 The Contract Price shall be inclusive of Custom Duties including Cess and GST against all materials and consumables envisaged to be imported for incorporation in the permanent works. It shall be clearly understood by the Contractor that custom duty shall neither be paid nor reimbursed by owner/Consultant. Contractor shall be fully responsible for port clearance including stevedoring, handling, unloading, loading, storage, inland transportation and receipt of materials at site etc. and cost thereof shall be included in the contract price. The contractor shall also be fully responsible for any delays, penalties, demurrages, shortages and other charges and losses, if any, in this regard.

17.2 The CIF value of materials envisaged to be imported for the purpose of permanent incorporation in the works shall be indicated separately in the Price Schedule. The custom duty and other import duties payable on the CIF value of materials imported for the purpose of permanent incorporation in the work shall be paid directly by the contractor and are included in the contact price. However, the Owner/Consultant shall pay statutory variation in custom duty (except GST component), if any, after the date of submission of last price bid & up to Contractual completion period but beyond the contractual completion period the statutory variation shall be to

18.0 CUSTOM DUTY ON CONSTRUCTION EQUIPMENTS

18.1 Contractor is liable to pay custom duty on the equipments brought into India for executing the project. The Contractor shall be fully liable for observing all the formalities in this regard as well as to pay the custom duty chargeable on the equipments, including any deposit payable for such purposes. No adjustment in contracted rates shall be permissible for any change in duty drawback applicable in respect of equipment & machinery brought in India for the use of the project and for re-export of equipment and machinery, on completion of the project.

18.2 If the Custom Authorities require the Contractor to furnish a bond to secure payment of any custom duty in respect of any import and that such Bond shall be furnished by the Employer/Consultant, the Employer/Consultant may at the request of the Contractor furnish the said Bond against the Contractor furnishing a Bank Guarantee to the Employer/Consultant, of the like amount in the form and

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

from a Bank in India approved by the Employer/Consultant.

18.3 If for any reason the Employer/Consultant is required by the Customs Authorities during pendency of Contract to pay any customs duty due to the importation or retention by the Contractor of any imports, the Contractor shall forthwith on demand by the Employer/Consultant pay the same to the Employer/Consultant, with the right in the Employer/Consultant (without prejudice to any other mode of recovery or right of the Employer/Consultant) to deduct the same from the on account and other payments due and/or becoming due or payable to the Contractor from time to time. The payments under such a case shall be subject to submission of Bank Guarantee from a Bank approved by Employer/Consultant, by the Contractor in favor of the Employer/Consultant for an amount equivalent to amount of custom duty.

18.4 The obligations undertaken and/or any bond or facility provided by the Employer/Consultant to the Contractor shall be based on the clear understanding that the said equipment shall be utilized by the Contractor only for the performance of the work covered under this contract and that the Employer/Consultant shall be discharged forthwith from all said obligations and shall be entitled forthwith to discontinue and recall any bond or other facility to the Contractor if the Contractor shall utilize or permit to be utilized the said equipment(s) or any of them for the performance of any work other than the work covered by the Contract in which event any amount due from Contractor in this connection shall also carry interest @ 22% (Twenty two percent) per annum from the date of relative payment by Employer/Consultant up to the date of recovery in full.


19.0 ISSUE OF ESSENTIALITY CERTIFICATE-VOID

20.0 IMPORT LICENCE

20.1 Contractor shall arrange import of all materials required for permanent incorporation in the works as well as construction equipment as per the guidelines laid down by the Government of India. OWNER/EIC shall not provide import license.

21.0 WITHHOLDING, ACCOUNTING AND TAX REQUIREMENTS

21.1 Contractor agrees for withholding from wages and salaries of its agents, servants or employees all sums, required to be withheld by the laws of the Republic of India or any other agency having jurisdiction over the area where Contractor is conducting operations, and to pay the same promptly and directly when due to the proper authority. Contractor further agrees to comply with all accounting and reporting requirements of any Nation having jurisdiction over the subject matter hereof and to conform to such laws and regulations and to pay the cost of such compliance. If requested, Contractor will furnish the evidence of payment of applicable taxes, in the country (ies) of the Contractor's and his sub-contractor(s) and expatriate employees.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

22.0 INTELLECTUAL PROPERTY

22.1 Neither OWNER/EIC nor Contractor nor their personnel, agents nor any sub-contractor shall divulge to any one (other than persons designated by the party disclosing the information) any information designated in writing as confidential and obtained from the disclosing party during the course of execution of the works so long as and to the extent that the information has not become part of the public domain. This obligation does not apply to information furnished or made known to the recipient of the information without restriction as to its use by third parties or which was in recipient's possession at the time of disclosure by the disclosing party. Upon completion of the works or in the event of termination pursuant to the provisions of the contract, Contractor shall immediately return to OWNER/EIC all drawings, plans, specifications and other documents supplied to the Contractor by or on behalf of OWNER/EIC or prepared by the Contractor solely for the purpose of the performance of the works, including all copies made thereof by the Contractor.

23.0 FIRM PRICE

23.1 The quoted prices shall be firm and shall not be subjected to price escalation till the work awarded during the validity of ARC period is completed in all respects.

24.0 WORKS CONTRACT

24.1 The work covered under this contract shall be treated as "Works Contract".

25.0 PROVIDENT FUND ACT


25.1 The Contractor shall strictly comply with the provisions of Employees Provident Fund Act and register them with RPFC before commencing work. The Contractor shall deposit Employees and Employers contributions to the RPFC every month. The Contractor shall furnish along with each running bill, the challan/ receipt for the payment made to the RPFC for the preceding months along with EPF Electronic Challan Cum Return (ECR) and on-line upload list of EPF Member.

26.0 **MOBILIZATION ADVANCE-** Not Applicable for this tender

27.0 CHANGE ORDERS/ EXTRA WORKS/ DEVIATIONS


27.1 A change order will be initiated in case:

- i) The OWNER/EIC directs the Contractor to include any addition to the scope of work not covered under this contract or delete any Section of the scope of the work under the contract.
- ii) Contractor requests to delete any part of the work which will not adversely affect the operational capabilities of the project and if agreed by the OWNER/EIC and

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

for which cost and time benefits shall be passed on to the OWNER/EIC.

- 27.2 Any changes required by the OWNER/EIC before giving their approval to detailed procedure or any other document relating to material procurement, layout plans etc for complying with the requirements of bidding document shall not be construed to be a change in the scope of work under the contract.
- 27.3 Any change order as above comprising an alteration which involves a change the cost of the works (which sort of alteration is hereinafter called a "variation") shall have impact on the contract value that shall be dealt towards end of contract. All change orders shall be approved by the EIC.
- 27.4 If the contract provides applicable rates for the valuation of the variation in question the contract price shall be increased or decreased in accordance with those rates. If the parties agree that the contract does not contain applicable rates then the parties shall negotiate a revision of the contract price which shall represent the change in cost of the works caused by the variations. Any change order must be duly approved by the OWNER/EIC in writing.
- 27.5 If there is a difference of opinion between Contractor and OWNER/EIC whether a particular work constitutes a change order or not, the matter shall be handled in accordance with the procedures set forth in Para 27.7.8 and 27.7.9 here below.
- 27.6 Within 10 (Ten) working days of receiving the comments from the Employer / Consultant on the documents submitted by the Contractor for approval, the Contractor's response in writing stating which item(s) is/are potential change (s), if applicable, will be submitted to the OWNER/EIC.
- 27.7 Procedure
- 27.7.1 During execution of work if the Contractor observes that any new requirements which is not specific or intended in the bidding document has been indicated by OWNER/EIC, they shall discuss the matter with OWNER/EIC's representatives.
- 27.7.2 In case such requirement arises from the side of the Contractor they would also discuss the matter with OWNER/EIC's Representative.
- 27.7.3 In either of the two cases above, the representatives of both the parties shall discuss the project requirement and mutually decide whether the project requirement constitutes a change order.
- 27.7.4 If it is mutually agreed that the project requirement/Inquiry constitutes a "Change Order" then a joint memorandum will be prepared to confirm a "Change Order" and basic ideas of necessary agreed modifications.
- 27.7.5 Contractor will study the work required in accordance with the Joint memorandum and assess subsequent schedule and cost effect if any.
- 27.7.6 The results of this study would be discussed mutually to enable OWNER/EIC to give a final decision whether Contractor should proceed with the Change Order or

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

not, in the best interest of the Project.

27.7.7 If OWNER/EIC's representative accepts the change order in writing then Contractor shall proceed with the work stipulated in the Change order. Time worked by all workmen employed and a statement showing the description and quantity of all materials and plant utilized for extra work shall be submitted to owner / EIC . The owner / EIC's representative shall sign and return to the contractor statement, as agreed. At the end of each month the Contractor shall deliver to the OWNER/EIC's representative a priced statement of the labor, materials and plant used. Whenever any dispute arises as to cost allocation between the Contractor and the OWNER/EIC, the voucher shall nevertheless be signed by the OWNER/EIC as a record of time worked and materials used. List and vouchers so signed will be the subject of negotiations between the owner / EIC and the contractor regarding their cost's allocation.

27.7.8 In case, mutual agreement as above that is whether Project Requirement constitutes a Change order or not, is not reached, then Contractor, in the interest of the project, shall take up the implementation of the work, if advised in writing to do so by OWNER/EIC's representative pending settlement between the two parties to the effect whether the Project Requirement constitutes a change order or not as per the terms and conditions of Contract Documents.

27.7.9 The time and cost effect in such a case shall be mutually verified for the purpose of record. Should it be established that the said work constitutes a Change Order, the same shall be compensated taking into account the records kept and in accordance with the contract.

27.7.10 Should the amount of Extra Work/ Change Order, if any, which the Contractor may be required to perform by the OWNER/EIC, fairly entitles the Contractor to extensions of time beyond the scheduled completion date for completion of either the whole of the works or for such Extra Work only, the OWNER/EIC and the Contractor shall mutually discuss and decide the extension of time, if any to be granted to the Contractor.


28.0 **VOID**

29.0 **CONSTRUCTION EQUIPMENT AND ORGANIZATION**

29.1 Schedule of Labour & Equipment Rates

Hiring / Recovery Rate for Deployment of Manpower attached as Annexure- 9 to SCC shall be used for analyzing rates for extra items and recovery for non- deployment of manpower.

29.2 Equipment Hiring / Recovery Rates attached as Annexure-10 to SCC shall be used for analyzing rates for extra items and recovery for non-deployment of equipment.


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

30.0 MECHANISED CONSTRUCTION

- 30.1 Contractor shall without prejudice to his overall responsibility to execute and complete the work as per specifications and time schedule adopt as far as practicable, mechanized construction techniques for major site activities. Contractor agrees that he will deploy the required numbers and types of the plant & machinery applicable for different activities in consultation with the Engineer-in-charge during execution of works.
- 30.2 Contractor further agrees that Contract price is inclusive of all the associated costs, which he may incur for actual mobilization, required in respect of use of mechanized construction techniques and that the OWNER/EIC/Consultant in this regard shall entertain no claim whatsoever.

31.0 GENERAL GUIDELINES DURING AND BEFORE ERECTION

- 31.1 Contractor shall be responsible for organizing the lifting of the equipment in the proper sequence, that orderly progress of the work is ensured and access routes for erecting the other equipments are kept open.
- 31.2 Orientation of all foundations, elevations, lengths and disposition of anchor bolts and diameter of holes in the support's saddles shall be checked by contractor well in advance. Minor rectifications including chipping of foundations as the case may be shall be carried out at no extra cost by the contractor after obtaining prior approval of the Engineer-in-Charge. The Contractor shall also be provided with the necessary structural drawings and piping layouts etc., wherever required for reference. During the structural member need to be dismantled, to facilitate the equipment erection, same shall be done by the contractor after ensuring proper stability of main structure with prior permission of Engineer-in-Charge. All such dismantled members shall be put in position back after the completion of equipment erection to satisfaction of Engineer-in-Charge.
- 31.3 During the performance of the work the Contractor at his own cost, shall keep structures, materials and equipment adequately braced by guys, struts or otherwise approved means which shall be supplied and installed by the Contractor as required till the installation work is satisfactorily completed. Such guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies.
- 31.4 Manufacturer's recommendations and detailed specifications for the installation of the various equipment and machines will be passed on to the contractor to the extent available during the performance of work. The requirements stipulated in these clauses shall be fulfilled by the Contractor.
- 31.5 Various tolerances required as marked on the drawings and as per specifications and instructions of the Owner/ Engineer-in-Charge shall be maintained. Verticality shall be maintained. Verticality shall be verified with the Theodolite.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

31.6 ERECTION OF EQUIPMENTS

31.6.1 All the erection shall be carried out by Cranes of suitable capacity. Erection by derrick shall not be permissible. The contractor shall arrange the crane of suitable capacity required for erection and include cost for same in respective items without any liability on the part of OWNER/EIC.

31.6.2 Bidder shall submit the indicative erection scheme for compressor/equipment and shall undertake the erection only after obtaining approval of erection scheme by Engineer-in-charge.

31.6.3 Grouting of equipments, anchor bolts, pockets and under base plates shall be carried out as per technical specifications.

32.0 PRICE ADJUSTMENT DUE TO DELAYED MOBILIZATION OR SHORTFALL IN MOBILISATION OF MINIMUM EQUIPMENT AND MANPOWER

32.1 VOID

32.2 In case during execution, adequate front is not available at site, contractor may request for delayed mobilization of certain equipment and submit for approval.


32.3 Contractor shall maintain record of actual mobilization of each equipment and key personnel. Joint record of equipment mobilization will be maintained month-wise. Further a copy of hindrance registers for the specified period (RA bill period) duly signed by contractor/ PMC/ Bhagyanagar Gas Limited(BGL) shall be maintained and submitted along with each RA bill.

32.4 In case of delay in mobilization or shortfall in mobilization of equipment and key personnel, recovery shall be affected from contractors running bills as certified by EIC (Engineer-IN-CHARGE). The recovery shall be for the delayed period for shortfall manpower and equipment beyond but not including the permissible mobilization period / month for each such equipment based on the hiring / recovery rates specified elsewhere in the bidding document.

32.5 If found necessary, BGL / PMC may deploy any equipment / manpower and recover the amount for such deployment at contractor risk and cost or as per rates provided at Annexure-09 & 10 to SCC respectively, whichever is higher.

32.6 Equipment and key personnel may be demobilized by the contractor on completion of its work at site after written clearance of Engineer-in-charge. Unilateral withdrawal of any equipment / key personnel by the contractor will attract recovery as per the hiring / recovery rates specified in Annexure-09 & 10 to SCC".

32.7 "Deduction under this clause is in addition to PRS applicable pursuant to GCC clause 27.0 and SCC Clause. The provision of GCC clause no. 27.0 shall have no

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

bearing on this clause. The - deployment of requisite minimum equipment and manpower shall be limited to 2.5% of contract price".

32.8 "In case time extension is granted without application of Price Reduction Schedule (PRS), then amount deducted on account of minimum equipment & Manpower will be refunded to the contractor".

32.9 In case of final bill, contractor shall be required to submit NOC from sub-contractor, if any (deployed after getting approval from BGL / PMC) about receipt of full payment from the contractor.

32.10 Contractor to submit quarterly closure reports jointly signed along with BGL/PMC.

33.0 MEASUREMENT OF WORKS

33.1 In addition to the provisions of relevant clause of GCC and associated provisions thereof, the provisions of Annexure-4 shall also apply.

34.0 TERMS OF PAYMENT

34.1 Basis and terms of payment for making Account shall be as set out in Annexure-5.

35.0 DELETED

36.0 ISSUE OF OWNER SUPPLIED MATERIAL

36.1 The conditions for issue of material and reconciliation refer enclosed Annexure-8.

36.2 The reconciliation of material shall be applicable only for the material issued by OWNER/EIC as free issue to the contractor.


37.0 LOCATION OF STORES

37.1 The tentative locations for Stores shall be as per the table mentioned below: -

Sr no.	GA	Store Location
1	Hyderabad	Mother station, Shamir pet
2	Vijayawada	Mother station, Vidyadharapuram
3	Kakinada	Mother station, Vakalapudi

37.2 Void

37.3 designated storage yard as directed by Engineer-in-Charge. Contractor shall

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------


arrange for handling of FIM including crane etc for loading/unloading, transportation of FIM to required site location free of cost.

38.0 STATUTORY APPROVALS

- 38.1 Employer shall obtain general in-principal permissions from most of the authorities having jurisdiction over the area as necessary for construction of the pipeline. However, for some of the permissions, if not available, Contractor shall do the follow up with the concerned authorities to get the permissions to execute the job in time. However, all the statutory payment required for such permissions shall be reimbursed by Employer at actual.
- 38.2 The Contractor shall arrange the inspection of the works by the authorities and necessary co-ordination and liaison work in this respect shall be the responsibility of the contractor. However statutory fees paid, if any, for all inspections and approvals by such authorities shall be reimbursed at actual by the OWNER/EIC to the contractor on production of documentary evidence.
- 38.3 Any change/ addition required to be made to meet the requirements of the statutory authorities shall be carried out by the contractor free of charge. The inspection and acceptance of the work by statutory authorities shall however, not absolve the contractor from any of his responsibilities under this contract.

39.0 TESTS AND INSPECTION

- 39.1 The Contractor shall carry out the various tests as enumerated in the technical specifications of this bid document and the technical documents that will be furnished to him during the performance of the work.
- 39.2 All the tests either on the field or at outside laboratories concerning the execution of the work and supply of materials by the Contractor shall be carried out by Contractor at his own cost.
- 39.3 The work is subject to inspection at all times by the Engineer-in-Charge. The contractor shall carry out all instructions given during inspection and shall ensure that the work is being carried out according to the technical specifications of this bid document, the technical documents and the relevant codes of practice will be furnished to him during the performance of the work.
- 39.4 The Contractor shall provide for purposes of inspection access ladders, lighting and necessary instruments at his own cost.
- 39.5 Any work not conforming to execution drawings, specifications or codes shall be rejected forthwith and the Contractor shall carryout the rectifications at his own cost.
- 39.6 All results of inspection and tests will be recorded in the inspection reports,


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Performa of which will be approved by the Engineer-in-Charge. These reports shall form part of the completion documents.

- 39.7 For materials supplied by OWNER/EIC, Contractor shall carryout the tests, if required by the Engineer- in-Charge, and the OWNER/EIC shall reimburse the cost of such tests at actual to the Contractor on production of documentary evidence.
- 39.8 Statutory fees paid to IBR authorities and for repeat tests and inspection due to failures, repairs etc. such reasons attributable to the Contractor shall be borne by the Contractor.
- 39.9 Inspection and acceptance of work shall not relieve the Contractor from any of his responsibilities under this Contract.

40.0 INSPECTION OF SUPPLY ITEMS

- 40.1 All inspection and tests on bought out items shall be made as per the specifications forming part of this contract. Various stages of inspection and testing shall be identified after receipt of Quality Assurance Programme from the Contractor/ Manufacturer.
- 40.2 Inspection calls shall be given for associations of OWNER / EIC's representative as per mutually agreed programme in prescribed Performa with 15 days margin, giving details of equipment and attaching relevant test certificates and internal inspection report of the Contractor. All drawings, General Arrangement and other contract drawings, specifications, catalogues etc. pertaining to equipment offered for inspection shall be got approved from OWNER/EIC and copies shall be made available to OWNER/EIC before hand for undertaking inspection.
- 40.3 The contractor shall ensure full and free access to the inspection Engineer of OWNER/EIC at the contractors or their sub contractors premises at any time during contract period to facilitate him to carry out inspection and testing assignments.
- 40.4 The contractor/ sub-contractor shall provide all instruments, tools, necessary testing and other inspection facilities to inspection engineer of OWNER/EIC free of cost for carrying out inspection.
- 40.5 Where facilities for testing do not exist in the sub- laboratories, samples and test pieces shall be drawn by the Contractor/ Sub-Contractor in presence of Inspection Engineer of a OWNER/EIC and duly sealed by the later and sent for testing in Government approved test house or any other testing laboratories approved by the inspection engineer at the contractors cost.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

41.0 FINAL INSPECTION

41.1 After completion of all tests as per specification the whole work will be subject to a final inspection to ensure that job has been completed as per requirement. If any defects noticed in the work attributable to Contractor, the Contractor at his own cost shall attend these, as and when the OWNER/EIC brings them to his notice. The OWNER/EIC shall have the right to have these defects rectified at the risk and cost of the contractor if he fails to attend to these defects immediately.

42.0 COMPENSATION FOR EXTENDED STAY

No additional compensation shall be provided for extended stay.

43.0 COMPUTERIZED CONTRACTORS BILLING SYSTEM

43.1 Without prejudice to stipulation in General Conditions of Contract, Contractor should follow following billing system.

43.2 The bills will be prepared by the contractors on their own PCs as per the standard formats and codification scheme proposed by OWNER/EIC. Contractors will submit these data to OWNER/EIC in an electronic media along with the hard copy of the bill, necessary enclosures and documents. The contractor will also ensure the correctness and consistency of data so entered with the hard copy of the bill submitted for payment.

43.3 OWNER/EIC will utilize these data for processing and verification of the Contractor's bill and payment."


44.0 TEMPORARY WORKS

44.1 All Temporary and ancillary works including enabling works connected with the work shall be responsibility of the Contractor and the price quoted by them shall be deemed to have included the cost of such works which shall be removed by the contractor at his cost, immediately after completion of his work.

45.0 DISTINCTION BETWEEN FOUNDATION AND SUPERSTRUCTURE

45.1 To distinguish between work in foundations and superstructures, the following criteria shall apply:

45.1.1 For all Equipment pedestals, pipe racks, other foundation and R.C.C. Structures, work done up to 300 mm level above finished grade level will be taken as work in foundations and work above this level will be treated as work in superstructures and payments would be made accordingly.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

45.1.2 For Buildings only, all works up to level corresponding to finished floor level shall be treated as 'Work in foundation' and all works above the finished floor level shall be treated as "Work in superstructure".

45.1.3 Irrespective of what has been stated above, all pavements, R.C.C. Retaining wall, all pipe sleepers and any similar item would be taken as work done in foundations irrespective of locations, nomenclature and levels given anywhere.

45.1.4 Where not specifically pointed out all works in Cellars/ sumps, Tank Pads, Cable trenches, or such similar item would be taken as work in foundation.

46.0 QUALITY ASSURANCE/ QUALITY CONTROL

46.1 Bidder shall include in his offer the Quality Assurance Programme containing the overall quality management and procedures, which is required to be adhered to during the execution of contract. After the award of the contract detailed quality assurance programme shall be prepared by the contractor for the execution of contract for various works, which will be mutually discussed and agreed to.

46.2 The Contractor shall establish document and maintain an effective quality assurance system outlined in recognized codes.


46.3 Quality Assurance System plans/procedures of the Contractor shall be furnished in the form of a QA manual. This document should cover details of the personnel responsible for the Quality Assurance, plans or procedures to be followed for quality control in respect of Engineering, Procurement, Supply, Installation, Testing and Commissioning.

The quality assurance system should indicate organizational approach for quality control and quality assurance of the construction activities, at all stages of work at site as well as at manufacture's works and dispatch of materials.

46.4 The OWNER/EIC or their representative shall reserve the right to inspect/witness, review any or all stages of work at shop/site as deemed necessary for quality assurance.

46.5 The contractor has to ensure the deployment of Quality Assurance and Quality Control Engineer(s) depending upon the quantum of work. This QA/QC group shall be fully responsible to carry out the work as per standards and all code requirements. In case Engineer-in-Charge feels that Contractor's QA/QC Engineer(s) are incompetent or insufficient, contractor has to deploy other experienced Engineer(s) as per site requirement and to the full satisfaction of Engineer-In-Charge.

46.6 In case contractor fails to follow the instructions of Engineer-in-charge with respect to above clauses, next payment due to him shall not be released unless until he

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

complies with the instructions to the full satisfaction of Engineer-in-charge.

46.7 The Contractor shall adhere to the quality assurance system as per EIC Specification enclosed in the Bidding Document as Annexure-6.

47.0 HEALTH SAFETY AND ENVIRONMENT (HSE) MANAGEMENT

47.1 The Contractor, during entire duration of the Contract, shall adhere to HSE requirement as per spec. enclosed in the bidding document as Annexure-7.

48.0 SITE CLEANING

48.1 The Contractor shall clean and keep clean the work site from time to time to the satisfaction of the Engineer-in-Charge for easy access to work site and to ensure safe passage, movement and working.

48.2 If the work involves dismantling of any existing structure in whole or part, care shall be taken to limit the dismantling up to the exact point and/or lines as directed by the Engineer-in-Charge and any damage caused to the existing structure beyond the said line or point shall be repaired and restored to the original condition at the Contractor's cost and risks to the satisfaction of the Engineer-in-Charge, whose decision shall be final and binding upon the Contractor. The Contractor shall be the custodian of the dismantled materials till the Engineer-in-Charge takes charge thereof.

48.3 The Contractor shall dispose off the unserviceable materials, debris etc. to any area as decided by the Engineer-in-Charge.


48.4 The Contractor shall sort out, clear and stack the serviceable materials obtained from the dismantling/renewal at places as directed by the Engineer-in-Charge.

48.5 No extra payment shall be paid on this account.

49.0 COMPLETION DOCUMENTS

49.1 Notwithstanding the provisions contained in standard specification, upon completion of work, the Contractor shall complete all of the related drawings to the "AS BUILT" stage (including all vendor/sub-vendor drawings for bought out items), all documents and provide the Owner / Consultant, the following:

- i) One complete set of all Drawings in PDF & Auto CAD formats.
- ii) Three complete sets of reduced size (279 mm x 432 mm) prints
- iii) Three complete bound sets of contractors specification including design calculations
- iv) Two copies of Daily Progress Report
- v) Three sets of all raw data collected/generated for and during execution of the entire job.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- vi) Construction Photo graphs (2 sets of hard copies)

49.2 Completion Document

49.2.1 The following documents (as per applicability depending on nature of work carried out) shall be submitted in hard binder by the CONTRACTOR in 3 (Four) sets, as a part of completion documents:

- i) Welding Procedure Qualification Report (if applicable)
- ii) Welder Qualification Report (if applicable)
- iii) Radiographic Procedure Qualification(if applicable)
- iv) Radiographic Report along with radiographs (Radiographs only with the original)(if applicable).
- v) Batch Test Certificate from manufacturers for electrodes (if applicable)
- vi) Hydrostatic and other test results & reports.
- vii) Pre-commissioning/ Commissioning checklist
- viii) Pre-commissioning/ Commissioning checklist.
- ix) All other requirements as specified in the respective specifications.
- x) As built drawings.
- xi) Any other drawing/document/report specified elsewhere in the bidding document

Note: The Contractor shall be eligible to apply for issuance of completion certificate after submission of completion documents (as per applicability depending on nature of work carried out) as mentioned above.


50.0 COORDINATION WITH OTHER AGENCIES

50.1 Work shall be carried out in such a manner that the work of other agencies operating at the site is not hampered due to any action of the Contractor. Proper coordination with other agencies will be Contractor's responsibility. In case of any dispute, the decision of Engineer-in-Charge shall be final and binding on the Contractor.

51.0 Deleted

52.0 UNDERGROUND AND OVERHEAD STRUCTURES

52.1 The information to possible extent regarding existing structures/overhead lines, existing pipelines and utilities are already available in the general layout drawings. Over and above contractor may encounter other structure/pipelines/ OFC etc. which may not be appearing in the available as built / general layout drawings, the contractor is required to collect such information on his own before commencing the work. The Contractor shall execute the work in such a manner that the said structures, utilities, pipelines etc. are not disturbed or damaged, and shall indemnify and keep indemnified the OWNER/EIC from and against any destruction thereof or damages thereto.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

53.0 TEST CERTIFICATES

53.1 Bidder shall be required to submit recent test certificates for the material being used in works from the recognized laboratories. These certificates should indicate all properties of the materials as required in relevant IS Standards or International Standards.

53.2 Contractor shall also submit the test certificate with every batch of material supplied which will be approved by Engineer-in-Charge. No secured advance will be given for the materials not having test certificate. In case any test is to be carried out, the same shall be got done in the approved laboratory at the cost of contractor.

54.0 ROYALTY

54.1 Contractor's quoted rate should include the royalty on different applicable items as per the prevailing Government rates. In case, OWNER/EIC is able to obtain the exemption of Royalty from the State Government, the contractor shall pass on the same to OWNER/EIC for all the items involving Royalty.

55.0 VOID.

56.0 SITE FACILITIES FOR WORKMEN

56.1 Following facilities are to be ensured at all work places where workmen are deployed/engaged by Contractor.


- i) Arrangement of first aid
- ii) Arrangement for clean drinking water.
- iii) Toilets
- iv) Canteen where tea & snacks are available
- v) A crèche where 10 or more women workmen are having children below the age of 6 years.

57.0 EXECUTION OF ELECTRICAL WORKS

57.1 The Contractor shall engage an approved electrical agency for execution of electrical works, holding valid electrical contractor license. In case contractor himself executes electrical works then he shall arrange valid electrical contractor license before start of electrical works at site. Not with-standing, contractor shall adhere to the entire safety standard as included in bidding document.

58.0 HYDROSTATIC TESTING

58.1 The bidder as per the technical specification along with their offer taking into account the completion schedule shall furnish the detailed procedure proposed for the hydrostatic testing of pipeline. The necessary piping, pumps etc. shall be provided by the contractor. The final disposal of water after testing shall be

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

contractor's responsibility. Suitable drains shall be provided for this purpose as directed by the Engineer-in-Charge within the contracted prices.

59.0 DELETED

60.0 MAKE OF MATERIALS

60.1 The bidder has to preferably bought out items from vendors listed in Approved vendor list.

60.2 If the item(s) is not available from listed vendors or the all listed vendor is unable to supply the item within time, then the bidder to submit the document indicating the non -availability of material from above list vendors.

60.3 For procuring "bought out items from vendors other than those listed above , the same may be acceptable subject to prior approval of owner to the following: -

- i) The vendor/ supplier of bought out item(s) is a regular and reputed manufacturer/ supplier of said item(s) for intended services and the sizes being offered is in their regular manufacturing/ supply range. Further, the bidder has to certify that the item(s) has/have been regularly used by them in all the CGD entities for at least last two years and they are working satisfactorily.
- ii) The Bidder to confirm that, the vendor/ supplier should not be in the Holiday list of Client / Any other PSU.
- iii) The bidder should enclose documentary evidences i.e. PO copies, Inspection Certificate, etc. for the above.


61.0 ADDITIONAL WORKS/ EXTRA WORKS

61.1 OWNER/EIC reserves their right to execute any additional works/ extra works, during the execution of work, either by themselves or by appointing any other agency, even though such works are incidental to and necessary for the completion of works awarded to the Contractor. In the event of such decisions taken by OWNER/EIC Contractor is required to extend necessary cooperation, and act as per the instructions of Engineer-in-Charge.

62.0 COMPENSATION FOR DELAY / PRICE REDUCTION SCHEDULE FOR ANY DELAY:

62.1 Clause No: 27.0 of GCC, pertaining to Price Reduction Schedule stands modified to the following extent:

Price Reduction will be applicable @ ½ % of the Release order contract value per week of delay or part thereof in completion of work subject to a maximum (ceiling) of 5% of total bill pertaining to the respective stations mentioned in the EIC's

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

intimation letter or Release order contract value.

For PRS purpose, Contract value shall be excluding of GST.
The price reduction schedule shall be applicable against individual release order with specific completion period and not on the total ARC value.

The compensation on account of any liability (lies) including penalties other than above shall be as per provisions of bidding documents and shall be applicable in addition to PRS.

63.0 PROJECT PLANNING, SCHEDULING AND MONITORING SYSTEM

The following schedules/documents/reports shall be prepared and submitted by the Bidder / Contractor for review/approval at various stages of the contract.

63.1 After the Award of Contract

a) Time Schedule

The Completion Time Schedule for the work (including mobilization period) as per Annexure- 3 to SCC of Tender in all respect, from the date of issue of telex/telegram/letter/Fax of Intent.

The Bidder is required to submit a Project Time Schedule. The Schedule shall cover all aspects like sub-ordering, manufacturing and delivery, indicated in the Bid Document. The OWNER interface activities shall be clearly identified with their latest required dates. OWNER reserves the right to disqualify the Bidder if the above Schedule submitted by the Bidder is not in line with the overall Project requirement.


b) Scheduling & Monitoring System

The Bidders should describe their system of Project Scheduling and monitoring, the extent of computerization, level of detailing, tracing methodology etc. with the name of computer package and sample outputs.

c) Overall Project Schedule

The Contractor shall submit within 1 week of Fax of Intent, a sufficiently detailed overall Project Schedule in the activity network form, clearly indicating the major milestones, interrelationship/ interdependence between various activities together with analysis of critical path and floats.

The network will be reviewed and approved by Engineer- in-Charge and the comments if any shall be incorporated in the network before issuing the same for implementation. The network thus finalized shall form part of the contract

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

document and the same shall not be revised without the prior permission from Engineer-in- Charge during the entire period of contract.

d) **Progress Measurement Methodology**

The contractor is required to submit within 1 week of award of WORK, the methodology of progress measurement of sub-ordering, manufacturing/ delivery, sub- contracting construction and commissioning works and the basis of computation of overall services/physical progress informed. OWNER reserves the right to modify the methodology in part or in full.

e) **Functional Schedules**

The contractor should prepare detailed functional schedules in line with network for functional monitoring and control and submit scheduled progress covers for each function viz. ordering, delivery and construction.

63.2 Project Review Meetings

The Contractor shall present the programme and status at various review meetings as required.

a) **Weekly Review Meeting**

Level of : contractors / consultants RCM/ Participation Site In- charge & Job Engineers.

Agenda : a) Weekly programme v/s actual achieved in the past week & programme for next week.
b) Remedial Actions and hold up analysis.
c) Client query/ approval.


Venue : HO/ Site Office

b) **Monthly Review Meeting**

Level of Participation : Senior Officers of OWNER/EIC and Contractors.

Agenda : a) Progress Status/ Statistics
b) Completion Outlook
c) Major holds ups/slippages
d) Assistance required
e) Critical issues
f) Client query/ approval

Venue : Office of OWNER, / or Site office at the discretion of OWNER/EIC

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

63.3 Progress Reporting Performance:

A) Monthly Progress Report

This report shall be submitted on a monthly basis within 10 (ten) calendar days from cut-off date, as agreed upon covering overall scenarios of the work. The report shall include, but not limited to the following:

- a) Brief Introduction of the work.
- b) Activities executed/ achievements during the month.
- c) Schedule versus actual percentage progress and progress curves for Detail Engg. Sub-ordering, Manufacturing/Delivery, Sub-contracting, Construction, Commissioning and Overall and quantum wise status & purchase orders against schedule.
- d) Area of concern/ problem/ hold-ups, impacts and action plans.
- e) Resources deployment status.
- f) Annexure giving status summary for drawings, MRs, deliveries, sub- contracting and construction.
- g) Procurement status for items to be supplied by Contractor.

B) Weekly Reports

The report will be prepared and submitted by the Contractor on weekly basis and will cover following items:

- a) Activities programmed and completed during the week.
- b) Resource deployed men and machines.
- c) Quantities achieved against target in construction
- d) Record of Man days lost.
- e) Construction percentage progress schedule and actual.


C) Daily Repots

- a) Activity programme for the day
- b) Progress of the previous day and commutative progress.
- c) Manpower & machinery deployed.

63.4 Progress Reports

63.4.1 CONTRACTOR shall make every effort to keep the OWNER adequately informed as to the progress of the WORK throughout the CONTRACT period.

CONTRACTOR shall keep the OWNER informed well in advance of the construction schedule so as to permit the OWNER to arrange for requisite inspection to be carried out in such a manner as to minimize interference with

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

progress of WORK. It is imperative that close coordination be maintained with the OWNER during all phases of WORK.

63.4.2 By the 10th (tenth) of each month, CONTRACTOR shall furnish the OWNER a detailed report covering the progress as of the last day of the previous month. These reports will indicate actual and scheduled percentage of completion of construction as well as general comments of interest or the progress of various phases of the WORK. The frequency of progress reporting by the CONTRACTOR shall be weekly.

63.4.3 Once a week, CONTRACTOR shall submit a summary of the WORK accomplished during the preceding week in form of percentage completion of the various phases of the WORK, to the OWNER.

63.4.4 Progress reports shall be supplied by CONTRACTOR with documents such as chart, networks, photographs, test certificate etc. Such progress reports shall be in the form and size as may be required by the OWNER and shall be submitted in at least 3 (three) copies.

63.4.5 Contractor shall prepare daily progress report (DPR) in the desired format and submit it to Engineer-in-charge along with schedule of next day to Engineer-in-charge.


64.0 RESPONSIBILITY OF CONTRACTOR

64.1 It shall be the responsibility of the Contractor to obtain the approval for any revision and/or modifications decided by the Contractor from the OWNER/EIC/ Engineer-in-charge before implementation. Also such revisions and/or modifications if accepted/ approved by the OWNER/EIC/Engineer-in- charge shall be carried out at no extra cost to the OWNER/EIC. Any changes required during and/or after approval for detailed construction drawings due to functional requirements or for efficient running of system keeping the basic parameters unchanged and which has not been indicated by the Contractor in the data/drawings furnished along with the offer will be carried out by the Contractor at no extra cost to the OWNER/EIC.

64.2 All expenses towards mobilization at site and demobilization including bringing in equipment, clearing the site etc. shall be deemed to be included in the prices quoted and no separate payments on account of such expenses shall be entertained.

64.3 It shall be entirely the Contractor's responsibility to provide, operate and maintain all necessary construction equipments, scaffoldings and safety gadgets, cranes and other lifting tackles, tools and appliances to perform the work in a workman like and efficient manner and complete all the jobs as per time schedules.

64.4 Preparing approaches and working areas for the movement and operation of the cranes, levelling the areas for assembly and erection shall also be the responsibility of the Contractor. The Contractor shall acquaint himself with access

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

availability, facilities such as railway siding, local labour etc. to provide suitable allowances in his quotation. The Contractor may have to build temporary access roads to aid his own work, which shall also be taken care while quoting for the work.

64.5 The procurement and supply in sequence and at the appropriate time of all materials and consumables shall be entirely the Contractor's responsibility and his rates for execution of work will be inclusive of supply of all these items.

65.0 CHECKING OF LEVELS

65.1 The Contractor shall be responsible for checking levels, orientation plan of all foundations, foundation bolts, etc., well in advance of taking up the actual erection work and bring to the notice of Engineer-in-Charge discrepancies, if any. In case of minor variations in levels etc. the Contractor shall carry out the necessary rectifications to the foundations within his quoted price.

65.2 The Contractor shall also be responsible for checking with templates, wherever necessary, the disposition of foundation bolts with the corresponding bases of structure and shall effect rectifications, as directed, within his quoted rate.

66.0 STORAGE FACILITIES

66.1 The Contractor shall maintain storage of the instruments as well as for calibration and testing of the instruments at his own cost. The contractor shall provide these facilities within the quoted price.

67.0 ABNORMALLY HIGH RATED ITEMS (AHR ITEMS)

Please refer clause no.of ITB, Vol I.

68.0 Deleted


69.0 Deleted

70.0 VOID

71.0 VOID

72.0 SUBMISSION OF COLOURED PHOTOGRAPHS

72.1 The Contractor shall shoot, prepare and submit colored photographs in 2 sets to EIC site office along with monthly progress report covering all the activities of highlighting the progress or other areas of work. Similarly photographs for problem areas should be submitted well in advance with a proposed methodology to execute the works and meet the construction schedule. The cost of same shall be

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

deemed to be inclusive in the rates and no separate payment shall be made.

73.0 DISPOSAL OF EMPTY CABLE DRUM

Deleted

74.0 VIDEO RECORDING & PHOTOGRAPHS (if required)

74.1 Contractor shall develop and submit a video recording for showing the nature and magnitude of the work along with construction photographs (if applicable)

75.0 SINGLE POINT RESPONSIBILITY

75.1 The entire work as per scope of work covered under this contract shall be awarded on single point responsibility basis.

76.0 SPARES


76.1 Contractor shall procure and supply all spare parts required during commissioning of the various items / materials supplied by him as enumerated in the Bidding Document. The quoted lump sum prices shall be deemed to have been inclusive of all such provision of commissioning spares, required till commissioning of such items. Contractor shall make available all the commissioning spares required at site at least 02 (two) weeks before start of commissioning. However, listed spares not used during commissioning shall be handed over to Employer at their designated place. Contractor shall also supply commissioning spares not listed but required during commissioning within the contracted price.

76.2 In addition to above, special tools & tackles required, if any, for operation & maintenance shall also be supplied by the Contractor and the quoted prices shall be deemed to have been inclusive of all such provisions.

77.0 BUILDING AND OTHER CONSTRUCTION ACT

- a. In order to govern welfare and working conditions of laborers engaged in construction activities, building and other construction work. Wherever applicable, The CONTRACTOR shall strictly comply with the following provisions pertaining to RE &CS
- b. The CONTRACTOR must be registered with the concerned authorities under the Building and -registration; the CONTRACTOR should obtain registration within one month of the award of contract.
- c. The CONTRACTOR shall be responsible to comply with all provisions of the Building and Other Construction Workers (RE&CS) ACT, 1996, the the Building and Other Construction Workers Welfare Cess Rules, 1998.

Cess as per the prevailing rate, shall be deducted at source from bills of the CONTRACTOR by the engineer-in-Charge of the contract and remitted to the secretary, building and other construction workers welfare Board of the concerned

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

sate the contractor shall be responsible to submit final assessment return of the cess amount to the assessing officer after adjusting the cess deducted at source.

78.0 BONUS FOR EARLY COMPLETION


The Clause 27.3 of GCC-Works for Bonus for early completion shall not be applicable in this Contract.

79.0 VOID

80.0 VOID

80.1 Statutory Compliance under Labour & Industrial Laws

1. The Contractor should produce necessary EPF Code before commencement of work.
 2. The Contractor should produce necessary ESIC Code before commencement of work or workmen who are not covered under ESII Act, the Contractor should take appropriate Workmen Compensation Insurance Policy and submit a copy of the same to OWNER.
 3. The contractor(s) are required to submit copies Electronic Challan cum Return (ECR)/ Electronic Challan along with online list of contract workers / members for proof of remittance of Provident Fund (PF) and Employee State Insurance (ESI) contribution with respective authorities for the contract workers engaged by him for the project, while submitting monthly bills.
 4. It shall be the sole responsibility of the contractor (including Contracting firm / company) to obtain and to abide by all necessary licenses / permission from the concerned authorities as provided under the various labour legislations including the labour license obtained as per the provisions of the Contract Labour (Regulation & Abolition) Act, 1970.
 5. The Contract shall discharge obligations as provided under various applicable statutory enactments including the Employees Provident Fund & miscellaneous Provisions Act, 195, the Employee State Insurance Act, 1948, the Contract Labour (Regulation & abolition) Act, 197, the Inter-state Migrant workmen (Regulation of employment & conditions of services) Act , 1979, the Minimum Wages Act, 1948, (Amendment) Ordinance 2007 and other relevant Acts, Rules and Regulations enforced from time to time.
1. The contractor shall be responsible for required contributions towards P.F, Pensions, ESI or any other statutory payments to be made in respect of the contract and the personnel employed for rendering services to OWNER and shall deposit these amounts on or before the prescribed dates. Every contractor shall submit responsible to pay any administrative / inspection charges thereof,


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

wherever applicable in respect of the personnel employed by him for the work of OWNER

2. The contractor shall regularly submit all relevant records / documents to OWNER representative for verification and upon such satisfaction only, OWNER will allow reimbursement of the amount paid.
3. The contractor/contracting firm shall pay the wages to the workers latest by 7th of the subsequent month at the rates as per the Minimum Wages Act and as notified by the Regional/Assistant Labour Commissioner (Central), Hyderabad from time to time in the presence of authorized representative of the Principal Employer i.e. Engineer In- Charge (EIC). The Engineer In-charge shall ensure that the contractor/contracting firm is making payment of wages to its labours not less than the wages notified by the appropriate authority from time to time. The contractor after disbursing the wages in the presence of Engineer In-Charge shall submit the copy of the register of wages to the management every month which shall necessarily contain following certification by the Engineer- In- Charge. " Certified that the amount shows in column No..... has been paid to the workman concerned in my presence on.... At....


If the contractor intends to pay the monthly wages/salaries to the workmen through bank/cheque, the necessary proof of payment (salary remittance proof) shall be submitted to the EIC. In this regard,

4. The contractor shall be directly responsible and indemnify the Company against all charges, dues, claims etc. arising out of the disputes relating to the dues and employment of personnel deployed by him.
5. The contractor shall indemnify OWNER/EIC against all losses or damages, if any, caused to it on account of acts of the personnel deployed by him.
6. The contractor shall ensure regular and effective supervision and control of the personnel deployed by him and give suitable direction for undertaking the contractual obligations.
7. No, labour below the age of 18 year shall be deployed.
8. In case the contractor intends to engage the labour from outside the state where project is being executed, they should comply with legal provisions under Inter-State Migrant Act.
9. The contractor shall be responsible to engage competent supervisor and monitor the jobs being performed by the persons to be deployed by the contractor.
10. The Contractor/Contracting firm shall obtain comprehensive insurance policy covering all risks such as accidents, injuries and death likely to be caused to his workers or to a third person including loss to the properties of OWNER or to some

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

other agency. The premium amount should be deposited with the insurance agency by the contractor regularly and without any delay.

11. In case of any accident resulting in injury or death in respect of the personnel deployed by the contractor during the execution of the work, the contractor shall be solely responsible for payment of adequate compensation, insurance amount, etc. to the person injured/next kith and kin of the deceased. Contractor shall indemnify OWNER from such liabilities.
12. The contractor/contracting firm shall not employ any person suffering from any contagious, loathsome or infectious disease. The contractor/contracting firm shall get examined his employees / workers through a Government Doctor before deployment.
13. No worker of contractor/contracting firm and contractor himself shall be allowed to consume alcoholic drinks or any narcotics within the plant/Terminal premises. If found under the influence of above, the contractor/contracting firm shall have to change/replace him, failing which, OWNER may terminate the contract.
14. The contractor/contracting firm shall indemnify OWNER against all claims, demands, actions, cost and charges etc. brought by any Court, Competent Authority / Statutory Authorities against any act or acts of the contractor/contracting firm or his workers.
15. The contractor/contracting firm shall deploy the workers after verification of their character and antecedents. In case any worker is found having criminal record, he shall have to be immediately replaced without any delay.
16. The persons to be deployed should be on rolls of the contractor/contracting firm.
17. The contractor/contracting firm shall issue proper identity cards to all the workers who are to be engaged for the job. The identity cards shall be signed by the contractor or his authorized representative. The contractor/contracting firm shall also be responsible for obtaining the gate passes from security in respect of all their personnel.
18. The supervision of the personnel shall be done by the contractor/contracting firm through their authorized representative and the name of the supervisor shall be invariably intimated to the Engineer-In-Charge at the commencement of contract.
19. The contractor shall be solely responsible for disciplining the personnel deployed by him. Further, he shall ensure that none of his workers create any nuisance or indulge in anti-social and criminal activities during the entire period of contract. In case, anybody is found indulging in such activities, then he will have to be immediately removed without any prejudice to further necessary action as deemed fit.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

20. The contractor/contracting firm shall be required to obtain labour license from Assistant Labour Commissioner (Central), if he engages 20 or more workmen/labours.

21. OWNER is empowered to impose punitive fines on contractor for violation of their safety rules & regulation.

82.0 Direct Payments to Sub-Vendors/ Supporting agencies of Main Contractor

Normally, the payment is to be made to vendor/ contractor only as per provision of contract. During execution, in case of financial constraints, OWNER may make direct payment to their sub-vendor/ supporting agencies as an exception from the amounts due to the vendors/ contractors from any of their bills under process upon certification by EIC subject to receipt of such request from the vendor/ contractor. Further, the request for direct payments to the sub-vendor/ sub-contractor shall be considered in performance evaluation of such vendor/ contractor.

83.0 Sub-letting of works

The contractor shall not, save with previous consent in writing of the Engineer-in-charge, sublet, transfer or assign the contract or any part thereof or interest therein or benefit or advantage thereof in any manner whatsoever.

Provided, nevertheless, that any such consent shall not relieve the contractor from any obligation, duty or responsibility under the contract.

However, subletting of WHOLE WORKS is prohibited. Vendor/ Contractor shall submit undertaking to this effect along with each invoice/ bill.

84.0 **WAY BILL / ROAD PERMIT:** Shall be issued by OWNER only for transportation of free issue material from one state to another.

85.0 Joints Measurement of Work Executed Billing, Invoice and Payments.


Measurement shall be recorded as per the methods of measurement spelt out in Specification/Contract Documents/ Procedure of OWNER. The PMC/BGL site engineer/DGM/CM will check the measurement as recorded in the Measurement Books/Bills

86.0 COMPLETION CERTIFICATE


completion certificate shall be issued by BGL. The provisions of GCC are modified to this extent.

88.0 ANNUAL RATE CONTRACT CONDITIONS:

i) The ARC contract shall be valid for 2.0 Years from the date of issuance of Fax of Acceptance (FOA).

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------


- ii) OWNER can award to contractor as per Schedule of Rates (SOR) in bid document as & when required during the validity of Rate Contract.
- iii) Contract Performance Bank Guarantee (CPBG) shall be applicable as per ITB & Bid Data Sheet (BDS).
The CONTRACTOR shall furnish to the EMPLOYER, within 30 days from the date of notification of award, a security in the sum of 10% of the accepted value of the tender or the actual value of work to be done whichever is applicable due to any additional work or any other reasons, in the form of a Bank draft/Banker's cheque or Bank Guarantee or irrevocable Letter of credit (as per proforma enclosed) as Contract Performance Security with the EMPLOYER which will be refunded after the expiry of DEFECTS LIABILITY PERIOD
- iv) Separate release order (s) will be placed for required work during the validity of Rate Contract. Price Reduction Schedule for delay in completion, Defect Liability Period and contract value for Limitation of Liability will be applicable for each order (i.e. Release order) separately. Completion period will be counted from date of release of order (letter of intimation).
- v) Owner envisages that there can be more than one front / section for performance of work (like Welding, Lowering of Pipes, civil, electrical, mechanical works, etc) at a time, accordingly contractor shall be required to work for the all front / sections simultaneously and each front / section shall be dealt exclusively separate so that project(s) schedule can be adhered to and completed on or before the date of completion.
- vi) Quantity in SOR is estimated and payment will be made on actual work done basis based on actual work performed issued.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

ANNEXURES TO SCC

CONTENTS

Annexure-1	:	Scope of Work
Annexure-2	:	Scope of Supply
Annexure-3	:	Time Schedule
Annexure-4	:	Measurement Work
Annexure-5	:	Terms of Payment
Annexure-6	:	Specification for Quality Assurance System requirements from Bidders
Annexure-7	:	Specification for Health, Safety and Environment (HSE) Management
Annexure-8	:	Conditions for issue & reconciliation of material
Annexure-9	:	Hiring/Recovery rate for Deployment of Manpower
Annexure-10	:	Equipment Hiring/Recovery Rates

 <p>Bhagyanagar Gas Limited</p>	<p style="text-align: center;">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p style="text-align: center;">VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------

**SCOPE OF WORK
(ANNEXURE-1 TO SPECIAL CONDITIONS OF CONTRACT)
ANNEXURE-1 TO SCC**

1.0 SCOPE OF WORK

Supply, construction, erection and commissioning of Mechanical and Electrical Works for CNG Stations (On-Line, Daughter Booster Stations, upgradation of CNG stations, etc if any) at Retail Outlets/ Dealers Stations/ COCO stations/ etc. Hyderabad, Vijayawada and Kakinada geographical Areas awarded to M/s BGL, namely:

Note:

1. Number and types of CNG Stations may vary as per project requirement and numbers provided are only indicative.
2. The scope of work also includes part works to be undertaken for completing CNG stations at OMC RO's (OLS/DBS/DCU) etc.




Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SCOPE OF SUPPLY
(ANNEXURE-2 TO SPECIAL CONDITIONS OF CONTRACT)**

 <p>Bhagyanagar Gas Limited</p>	<p style="text-align: center;">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p style="text-align: center;">VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------

ANNEXURE-2 TO SCC

1.0 SCOPE OF SUPPLY

1.1 Owner's Scope of Supply

Owner's scope of supply shall be specified in particular job specification(if any) , Technical Specifications, Schedule of Rates & various other parts of the Bidding Document.

Free Issue Materials shall be issued to the Contractor from the designated store(s) of Owner. Contractor shall be responsible for lifting the free issue materials from owners storage point(s) and transporting the same to work site(s) at his own cost. Conditions for Issue and Reconciliation of Materials shall be as per Document enclosed as Annexure-8 to Special Conditions of Contract.

1.2 Contractor Scope of Supply

All materials except what is under owner's scope of supply as mentioned in clause No.1.1 above, and required for successful completion of works in all respects shall be supplied by the Contractor and the cost of such supply shall be deemed to have been included in the quoted price without any additional liability on the part of Owner.




Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**TIME SCHEDULE
(ANNEXURE-3 TO SPECIAL CONDITIONS OF CONTRACT)**

 Bhagyanagar Gas Limited	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
--------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

ANNEXURE-3 TO SCC

TIME SCHEDULE

The work shall be carried out on Annual rate contract basis. The validity of Annual Rate Contract shall be for a period of 02 years (24 months) from the date of issuance of FOA/WO. The Completion period for various types of stations shall be as follows:

1. For supply, erection and commissioning of mechanical and electrical works for CNG stations (OLS/ DBS/ DS/ DCU/ upgradation/ etc.) to be developed at various existing retail outlets / dealers owned stations, etc. -4 weeks for each station from the date of issuance of EIC intimation for nos. of stations mentioned / allocation of retail outlets or COCO stations.

Note:

- i) As per availability of work front, contractor can be asked to work for all/few of the CNG Stations covered under Scope of work awarded, with each station to be completed as per above stated time schedule.
- ii) Date of intimation through any mode of communication including Minutes of Meeting shall be considered as date of Release Order.
- iii) Date of intimation for various types of CNG stations shall be considered as the date of handing over of respective sites by BGL.
- iv) If intimation is given to multiple stations at a time, then also time schedule is 4 weeks from the date of intimation to all stations. i.e. Bidder has to complete all station with 4 in weeks from the date of intimation.

(STAMP & SIGNATURE OF BIDDER)




Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

MEASUREMENT OF WORK

(ANNEXURE- 4 TO SPECIAL CONDITIONS OF CONTRACT)


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Annexure-4

Measurement of Work

GENERAL

- 1.0 The mode of measurement shall be as mentioned in relevant standard specification incorporated in the Bidding Document. Any other mode of measurements not covered in above specifications shall be followed in accordance with relevant BIS codes/ Schedule of Rates/ Specifications etc. and/ or as decided by Engineer-in- charge.
- 1.1 Payment will be made on the basis of joint measurements taken by Contractor and certified by Engineer-in- Charge. Measurement shall be based on “ Approved / issued for construction” drawings, to be the extent that the work conforms to the drawings and details are adequate.
- 1.2 Wherever work is executed based on instructions of Engineer-in-charge or details are not adequate in the drawings, physical measurements shall be taken by Contractor in the presence of Engineer-in-charge.
- 1.3 Measurements of weights shall be in metric tonnes corrected to the nearest Kilogram. Linear measurements shall be in meters, centimeters and millimeters as appropriate.
- 1.4 Welds, bolts, nuts, washers etc. shall not be measured. Rates for structural steel work shall be deemed to include the same.
- 1.5 No other payment either for temporary works connected with this Contractor for any other item such as weld, shims, packing plates etc. shall be made. Such items shall be deemed to have been included for in the rates quoted.
- 1.6 Measurement will be made for various items under schedule of rates on the following basis as indicated in the unit column.
 - i) Weight : MT or Kg
 - ii) Length : M (Meter), CM (centimeters) and MM (millimeters)
 - iii) Number : No.
 - iv) Volume : Cu. M
 - v) Area : Sq. M
- 1.7 All measurements shall be in metric system. All the works in progress will be jointly measured by the representative of the Engineer-in-charge and the contractor's authorized agent progressively. Such measurements will be either recorded/typed by the contractor in the numbered measurement sheets to be supplied by Engineer-in- Charge / Owner or computerized by Contractor themselves. The measurements shall be signed in token of acceptance by the contractor or his authorized representative. The contractor shall submit the bill in the approved Performa in triplicate to the Engineer- in-Charge of the work.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

2.0 ELECTRICAL WORKS

2.1 Cables

The measurement for cable laying shall be made on the basis of length actually laid from lug to lug including that of loops provided and paid accordingly.

- 2.2 The weights mentioned in the drawing or shipping list shall be the basis for payment. If mountings are sent separately (for panels etc.) to facilitate transportation then erection weight shall be inclusive of all mountings. For structural steel measurements/payment shall be made as per finished items.

3.0 INSTRUMENTATION WORKS

- 3.1 Measurement of primary piping/ tubing between piping or equipment on one side and the instrument on the other side will be from the first break flange or tubing fitting up to the first block valve of fabricated instrument manifold or up to first tee of instrument manifold for integral type manifolds. All piping / fittings at the first block valve or the piping / equipment side up to break flange or tubing fittings shall be excluded. Any valve manifold tubing forming part of manifold or drain connection for instruments up to 1.5 meters individually or each drain connection shall be excluded.

- 3.2 Air lines and any other utility lines will be measured from end to end including valves and pipe fittings.

- 3.3 Copper tube measurement will be taken between the two fittings of the copper tube.

- 3.4 Direct mounted instrument and instruments mounted on support shall be accounted in terms of the quantity in numbers.

- 3.5 Multi-core cables/multi-tubes will be measured between the junction box and its termination inside the control room."

- 3.6 Two/Three core cables shall be measured between two end terminals.

- 3.7 No separate payment will be made for receiving, handling and transportation of owner issued materials from owner's storage points to contractor's store/workshop and the same are deemed to be included in the unit rates for the respective item of work."


3.8 Erection Weights

The weights mentioned in the drawings or shipping list shall be the basis of payment. If mountings are sent separately (for panel etc.) to facilitate transportation, then erection weight shall be inclusive of all such mountings. For structural steel, measurements / payment shall be made as per finished items."

4.0 PAINTING ON EQUIPMENTS /STRUCTURAL STEEL ETC.

a) EQUIPMENTS

- I) For columns, vessels, reactors, Exchangers, furnaces, ejectors etc., measurement shall be on square meter basis taken over the painted surface.
- II) For pumps, motors and compressors measurement shall be made on number basis.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

b) **PAINTING ON STEEL STRUCTURE**

- I) Payment for steel structures shall be made on the basis of admissible weight of structure painted.
- II) Welds, bolts, nuts, washers etc. shall not be measured and rates for painting of structure shall be inclusive of painting such items.

**TERMS OF PAYMENT
(ANNEXURE-5 TO SPECIAL CONDITIONS OF CONTRACT)
ANNEXURE-5 TO SCC**

(A) **TERMS OF PAYMENT**

Pending completion of the whole works, provisional progressive payments for the part of work executed by the contractor shall be made by Owner on the basis of said work completed and certified by the owners representative as per the agreed payment schedule and the percentage break-ups given below.

Contractor shall submit his invoices to the owner's representative in the manner as instructed by Owner. Each invoice will be supported by documentation acceptable to Owner and certified by the owner's representative. Payments made by owner to the contractor for any part of the work shall not deem that the Owner has accepted the work. Owner will release payment through e- payments only as detailed in the bidding document.


1.0 **Composite Works at CNG STATION**

1.1 **Tubing Works (Laying)**

- a) 70% on erection and alignment complete to achieve mechanical completion.
- b) 20% on completion of all testing.
- c) 10% on completion of all activities and their acceptance. Submission of final documents, final bill and acceptance of these by owner thereafter for successful closure of work order.

1.2 **Civil and Architectural Works**

- a) 90% on completion of work on pro-rata basis as certified in running bills.
- b) 10% on completion of all activities and their acceptance. Submission of final documents, final bill and acceptance of these by owner thereafter for successful closure of work order.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

1.3 Structural Works

- a) 45% on supply and acceptance of material at site.
- b) 45% on fabrication, erection, alignment, welding, painting, etc.
- c) 10% on completion of all activities and their acceptance. Submission of final documents, final bill and acceptance of these by owner thereafter for successful closure of work order.

1.4 Items including supply & Erection of finished goods (Mechanical, and Instrumentation)

- a) 70% on receipt of material at site and acceptance thereof.
- b) 15% on erection, alignment, grouting, painting, etc.
- c) 5% on testing.
- d) 10% on completion of all activities and their acceptance. Submission of final documents, final bill and acceptance of these by owner thereafter for successful closure of work order.

1.5 Items including supply of finished goods (Mechanical)

- a) 80% on receipt of material at site and acceptance thereof.
- b) 20% on completion of all activities and their acceptance. Submission of final documents, final bill and acceptance of these by owner thereafter for successful closure of work order.

1.6 Equipment Erection Works


- a) 45% on installation in position.
- b) 30% after initial alignment, levelling and grouting.
- c) 15% after final alignment and making ready for commissioning.
- d) 10% on completion of all activities and their acceptance. Submission of final documents, final bill and acceptance of these by owner thereafter for successful closure of work order.

1.7 Items including supply of finished goods (Electrical) including supply of finished goods and Erection and installation Works

- a) 80% on completion of supply and installation.
- b) 10% on testing.
- c) 10% on completion of all activities and their acceptance. Submission of final documents, final bill and acceptance of these by owner thereafter for successful closure of work order.

1.8 For Lumpsum Items

- For all lumpsum items included in schedule of rates,
- a) Completion of work : 90% progressively

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

b) Completion of all activities and their acceptance: 10% Submission of final documents

1.9 Supply of Materials and All Other Works not covered above

- a) Completion of individual items of work : 90% progressively
b) Completion of all activities and their acceptance. : 10% Submission of final documents, final bill and acceptance of these by owner thereafter for successful closure of work order.


Note: Any further breakup of each activity for the payment purpose can be done depending upon the site situation/requirement and recommendation by Engineer-In charge .

2.0 PAYMENT METHODOLOGY

1. The contractor shall raise invoices and shall enclose all documents as per check list issued by PMC/ Owner. All the RA bills are to be submitted to EIC (PMC/ BGL).
2. Employer will release payment through e-payments only as detailed in the Bidding Document.
3. Further break-up of Lumpsum Prices, if deemed necessary for any progressive payment of individual item may be mutually arrived at between Engineer-in-Charge and the Contractor.
4. All payments against running bills are advance against the work and shall not be taken as final acceptance of work / measurement carried out till the final bill.
5. The Contractor shall be responsible to submit the invoices to EIC or designated person in BGL.
6. The contractor shall submit monthly RA bills along with. Following documents are to be provided along with Measurement Book & Abstract of Measurement
 - Measurement sheets duly verified and certified by EIC, in support of the works executed as per SOR for the billing period.
 - Copy of PF remittance challan
 - Copy of ESIC remittance
 - Copy of wage register
 - Two sets of construction photographs.

In the absence of the requisite documents, the measurement Book / Abstract of measurement shall be returned to the contractor.
7. Successful bidder(s) to submit material reconciliation certificate along with each bill.
8. Bills shall be raised by contractor in line with check list attached in Tender document.

9. E Payment

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- i) BGL has initiated payments to Contractors electronically, and to facilitate the payments electronically through 'e-banking'.

**SPECIFICATION FOR
QUALITY ASSURANCE SYSTEM REQUIREMENTS
(Annexure - 6 to SCC)
(For Details - Refer SOW of the Tender)**



Bhagyanagar Gas
Limited


**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

STANDARD SPECIFICATION FOR

**HEALTH, SAFETY AND ENVIRONMENTAL (HSE)
MANAGEMENT AT CONSTRUCTION SITES**


(ANNEXURE 7 to SCC)

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

CONTENTS

SL. NO. DESCRIPTION

1.0	SCOPE
2.0	REFERENCES
3.0	REQUIREMENT OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLETED BY BIDDERS.
4.0	DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR
5.0	RECORDS
	ANNEXURE - A
	ANNEXURE - B
	ANNEXURE - C
	ANNEXURE - D
	ANNEXURE - E

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

1.0 SCOPE

This specification establishes the Healthy, Safety and Environment (HSE) management requirement to be compiled with by the Contractors during construction.

This specification is not intended to replace the necessary professional judgement needed to design & implement an effective HSE system for construction activities and the contractor is expected to exceed requirements given in this specification. Requirement stipulated in this specification shall supplement the requirement of HSE management given in relevant Act (S)/ legislations. General Condition of Contract (GCC) Special Condition of Contract (SCC) and Job Specifications. Where different documents stipulate different requirements, the most stringent shall be adopted.

2.0 REFERENCES

This document should be read in conjunction with following:

- General Conditions of Contract (GCC)
- Special Conditions of Contract (SCC)
- Building and other construction workers (regulation of employment and condition of service) Act, 1996
- Job Specifications
- Relevant IS Codes (refer Annexure-A)
- Reporting Formats (refer Annexure-B)
- Statutory requirements


3.0 REQUIREMENT OF HEALTH, SAFETY & ENVIRONMENT (HSE) MANAGEMENT SYSTEM TO BE COMPLETED BY BIDDERS.

3.1 Management Responsibility

3.1.1 The Contract should have a document HSE policy to cover commitment of the organization to ensure health, safety and environment aspects in their line of operations

3.1.2 The HSE management system of the Contractor shall cover HSE requirement including but not limited to what specified under clause 1.0 & 2.0 mentioned above


3.1.3 Contractor shall be fully responsible for planning and implementing HSE requirement to the satisfaction of the company. Contractor as a minimum requirement shall designate/deploy the following to co-ordinate the above:

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------


No. Of workers deployed	
Up to 250	Designate one safety supervisor who will guide the workers from time to time, as well as impart training basic guidelines at least weekly once.
Above 250 & up to 500	Deploy one qualified and experienced safety Engineer/ Officer who will guide the workers from time to time as well as impart basic guideline & training at least weekly once. He/ She shall possess a recognized Degree in any branch of engineering or technology or architecture and had a post qualification construction experience of minimum two years or possess a recognized Diploma in any branch of engineering or technology or Graduate in Science stream and had a post qualification construction experience of minimum five years.
Above 500	One additional safety engineer/Officer (for every 500 or less) whose function will be as mentioned above
*Contractor shall indemnify and hold harmless BGL./ PMC & their representatives from any and all liabilities arising out of nonfulfillment of HSE requirements.	

Above is the minimum requirement and the Contractor shall ensure physical presence of a safety personnel at each place where Hot work permit is required. No work shall be started at site until above safety personnel are physically present at site. The contractor shall submit a safety organogram clearly indicating the lines of responsibility and reporting system. He shall furnish Bio-Data/Resume/Curriculum Vitae of the safety personnel he intends to mobilize, at least 1 month before the intended mobilization, for PMC/ BGL.'s approval.

- 3.1.4 The Contractor shall ensure that the Health, Safety and Environment (HSE) requirements are clearly understood & faithfully implemented at all levels, at each and every site/ work place.
- 3.1.5 The Contractor shall promote and develop consciousness for Health, Safety and Environment among all personnel working for the Contractor. Regular awareness programs and fabrication shop/work site meeting shall be arranged on HSE activities to cover hazards involved in various operations during construction.


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- 3.1.6 Arrange suitable first aid measures such as First Aid Box, trained personnel to give First Aid, Standby Ambulance or Vehicle and install fire protection measures such as: adequate number of steel buckets with sand and water and adequate fire extinguishers to the satisfaction of BGL./ PMC. In case the number of workers exceeds 500, the Contractor shall position an ambulance /vehicle on full time basis very close to the worksite.
- 3.1.7 The Contractor shall evolve a comprehensive planned and documented system for implementation and monitoring of the HSE requirements. This shall have submitted to BGL. & PMC for approval well in advance, prior to start of work. The monitoring for implementation shall be done by regular inspection and compliance to the observations thereof. The Contractor shall get similar HSE requirements implemented at his sub-contractor (s) work site/ Office. However, compliance of HSE requirement shall be the sole responsibility of the Contractor. Any review/ approval by BGL./ PMC shall not absolve the Contractor of his responsibility/ liability in relation to all HSE requirements.
- 3.1.8 Non-Conformance on HSE by the Contractor (including his Sub-contractors) as brought out during review/ audit by PMC/ BGL. representative shall be resolved forthwith by Contractor. Compliance report shall be possibility submitted to PMC/ BGL. at the earliest.
- 3.1.9 The Contractor shall ensure participation of his Resident Engineer/Site-in-Charge in the Safety Committee/HSE Committee meetings arranged by BGL./ PMC. The compliance of any observation shall be arranged urgently. Contractor shall assist BGL./ PMC to achieve the targets set by them on HSE during the project implementation.
- The contractor shall ensure that his staff members & workers (permanent as well casual) shall not be in a state of intoxication during working hours and shall abide by any law relating to consumption & possession of intoxicating drinks or drugs in force. Awareness about local laws on this issue shall form part of the Induction Training.
- The contractor shall ensure that all personnel working for him comply with No-smoking requirements of the BGL. as notified from time to time. Cigarettes, lighters, auto ignition tools or appliances shall not be allowed inside the plant complex. Smoking shall be permitted only inside smoking booths expressly designated & authorized by the BGL./ PMC.
- 3.1.10 The Contractor shall adhere consistently to all provisions of HSE requirements. In case of non-compliance or continuous failure in implementation of any of HSE provisions; BGL./ PMC may impose stoppage of work without any Cost & Time implication to BGL. and/or impose a suitable penalty for non-compliance with a notice of suitable period, upto a cumulative limit of 1.0% (one percent) of Contract value with a ceiling of Rs. 10 lakhs.
- 0.2% (Zero decimal two percent) of the contract value for LSTK, EPC, EPCC or Package contracts with an overall ceiling of Rs. 1,00,00,000/- (Rupees one crore).

 <p>Bhagyanagar Gas Limited</p>	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------

S. No.	Violation or HSE norms	Penalty Amount
1.	For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)	Rs. 250/-per day/person
2.	Working without Work Permit/ Clearance	Rs.5,000/- per occasion
3.	Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire/ cables on the roads, electrical jobs by incompetent person, etc.)	Rs. 3,000/- per item per day.
4.	Working at height without full body harness, using non-standard/ rejected scaffolding and not arranging fall protection arrangement as required like Safety Nets.	Rs.1,000/ per case per day

S. No.	Violation or HSE norms	Penalty Amount
1.	For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)	Rs. 250/-per day/person
2.	Working without Work Permit/ Clearance	Rs.5,000/- per occasion
3.	Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire/ cables on the roads, electrical jobs by incompetent person, etc.)	Rs. 3,000/- per item per day.
4.	Working at height without full body harness, using non-standard/ rejected scaffolding and not arranging fall protection arrangement as required like Safety Nets.	Rs.1,000/ per case per day
5.	Unsafe handling of compressed gas cylinders (No trolley, jubilee clips double gauge regulator, improper storage/ handling).	Rs. 100/- per item per day
6.	Use of domestic LPG for cutting purpose.	Rs. 1,000/- per occasion
7.	No fencing/ barricading of excavated areas.	Rs. 1,000/- per occasion
8.	Not providing shoring/ strutting/ proper slope and not keeping the excavated earth at least 1.5 M away from excavated area.	Rs. 5,000/- per occasion
9.	Non display of caution boards, list of hospitals, emergency services available at work locations.	Rs.500/- per occasion
10.	Traffic rules violations like over speeding of vehicles, rash driving, wrong parking, not using seat belts, vehicles not fitted with reverse warning alarms.	Rs. 1,000/- per occasion
11.	Absence of Contractor's top most executive at site in the safety meetings whenever called by PMC/ BGL.	Rs. 1,000/- per occasion

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

12.	Failure to maintain safety records by Contractor Safety personnel.	Rs.1,000/- per month.
13.	Failure to conduct daily safety site inspection, HSE meeting and HSE audit at predefined frequencies.	Rs.1,000/- per occasion
14.	Failure to submit the monthly HSE report by 5 th of subsequent month to Engineer- in-Charge.	Rs. 1,000/- per occasion and Rs. 100/- per day for further delay.
15.	Poor House Keeping	Rs.1,000/- per occasion
16.	Failure to report & follow up accident (including Near Miss) reporting system.	Rs. 10,000/- per occasion
17.	Degradation of environment (not confining toxic spills oil/ lubricants onto ground)	Rs. 1,000/- per occasion
18.	Not medically examining the workers before allowing them to work at height, not providing ear muffs while allowing them to work in noise polluted areas, made them to work in air polluted areas without respiratory protective devices, etc.	Rs.1,000/- per occasion
19.	Violation of any other safety condition as per job HSE plan, work permit and HSE conditions of contract (using crowbar on cable trenches, improper welding booth, not keeping fire extinguisher ready at hot work site, unsafe rigging practices, non-availability of First-Aid box, etc.)	Rs.1,000/- per occasion
20.	Any violation not covered above.	To be decided by BGL./ PMC


This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stoppage of work, its extent & monetary penalty shall rest with PMC/ BGL. & binding on the Contractor.

3.1.11 All fatal accidents and other personnel accidents shall be investigated by a team of contractors senior personnel for root cause and recommend corrective and preventive actions. Findings shall be documented and suitable actions taken to avoid recurrences shall be communicated to BGL/ PMC. BGL shall have the liberty to independently investigate such occurrences, and Contractor shall extend all necessary help and co-operation in this regard. PMC/ BGL. shall have to right to share the content of this report with the outside world.

3.2 House Keeping

3.2.1 Contractor shall ensure that a high degree of house-keeping is maintained and shall ensure the followings:


- a. All surplus earth and debris are removed/disposed off from the working site to identified location (s).
- b. Unused/Surplus Cables Steel items and steel scrap lying scattered at different places within the working areas are removed to identified location (s).

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- c. All wooden scrap, empty wooden cable drums and other combustible packing materials shall be removed from work place to identified location(s).
- d. Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete chips and bricks, etc. shall not be allowed in the roads to obstructs free movement of men & machineries.
- e. Fabricated steel structurals, pipes & piping materials shall be stacked properly for erection.
- f. Water logging on rods shall not be allowed.
- g. No parking of trucks/ trolleys, cranes and trailers etc. shall be allowed on of roads, which may obstruct the traffic movements.
- h. Utmost care shall be taken to ensure over all cleanliness and proper up keep of the working areas.
- i. Trucks carrying sand, earth and pulverized materials etc. shall be covered while moving within the plant areas.
- j. The contractor shall ensure that the atmosphere in plant area and on roads is free from particulate matter like dust, sand, etc. by keeping the top surface wet for ease in breathing.
- k. At least two exits for any unit area shall be assured at all times.

3.3 Healthy, Safety and Environment

- a) The Contractor shall provide safe means of access to any working place including provision of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen, and BGL./ PMC. Contractor shall ensure deployment of appropriate equipment and appliances for adequate safety and health of the workmen and protection of surrounding areas.
Contractor shall ensure identification of all Occupational Health, Safety & Environmental hazards in the type of work he is going to undertake and enlist mitigation measures. Contractor shall carry out Job Safety Analysis (JSA) specifically for high risk jobs like working at height & in confined space, deep excavations, radiography jobs, electrical installations, blasting operations, demolishing/ dismantling activities, welding/ gas cutting jobs and submit the findings to PMC/ BGL.. The necessary HSE measures devised shall be in place prior to start of an activity by the contractor.
- b) The Contractor shall ensure that all their staff workers including their sub- Contractor (s) shall wear Safety Helmet and Safety shoes. Contractor shall also ensure use of safety belt, protective goggles, gloves etc. by the personnel as per jobs requirements. All these gadgets shall conform to relevant IS specification equivalent.
The Contractor shall ensure that all their staff, workers and visitors including their sub-contractor(s) have been issued (records to be kept) & wear appropriate PPEs like nape strap type safety helmets preferably with head & sweat band with ¾" cotton chin strap (made of industrial HDPE), safety shoes with steel toe cap and antiskid sole, full body harness (CE marked and conforming to EN361), protective goggles, gloves, ear muffs, respiratory protective devices, etc. All these gadgets shall conform to applicable IS Specifications/ CE or other applicable international standards.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

BGL. may issue a comprehensive color scheme for helmets to be used by various agencies. The Contractor shall follow the scheme issued by the BGL. All Safety/ Fire personnel shall preferably wear red colour helmet so that workmen can approach them for guidance during emergencies.

For shot blasting, the usage of protective face shield and helmets, gauntlet and protective clothing is mandatory.

For offshore jobs/contracts, contractor shall provide PPEs (new) to PMC & BGL.'s personnel, at his (contractor's) cost. All personnel shall wear life jacket at all time.

An indicative list of HSE standards/codes is given under Appendix-A.

The contractor shall issue height permit for working at height after verifying and certifying the checkpoints as specified in the attached permit (Format No. HSE-6). He shall also undertake to ensure compliance to the conditions of the permit during the currency of the permit including adherence to personal protective equipments.

The permit shall be issued initially for one week or expected duration of an activity and extended further for the balance duration. This permit shall be applicable in areas where specific clearance from BGL.'s operation Deptt./ Safety Deptt. is not required. PMC field Engineers/ Safety Officers/ Area Coordinators may verify and counter sign this permit (as an evidence of verification) during the execution of the job.

In case work is undertaken without taking sufficient precautions as given in the permit, PMC Engineers may cancel the permit and stop the work till satisfactory compliance is arranged. Contractors are expected to maintain a register for issuance of permit and extensions thereof including preserving the used permits for verification during audits etc.

Contractor shall arrange (at his cost) and ensure use of Fall Arrester Systems by his workers. Fall arresters are to be used while climbing/ descending tall structures. These arresters should lock automatically against the anchorage line, restricting free fall of the user. The device is to be provided with a double security opening system to ensure safe attachment or release of the user at any point of rope. In order to avoid shock, the system should be capable of keeping the person in vertical position in case of a fall.

Contractor shall ensure that Full body harnesses conforming EN361 and having authorized CC marking is used by all personnel while working at height. The lanyards and life lines should have enough tensile strength to take the load of the worker in case of a fall. One end of the lanyard shall be firmly tied with the harnesses and the other end with life line. The harness should be capable of keeping the workman vertical in case of a fall, enabling him to rescue himself.

Contractor shall provide Roof Top Walk Ladders for carrying out activities on sloping roofs in order to reduce the chances of slippages and falls.

- c) Contractor shall ensure that a proper Safety Net System shall be used at appropriate locations. The safety net shall be located not more than 30 feet (9.0 metres) below the working surface at site to arrest or to reduce the consequences of possible fall of persons working at different heights.
- d) Contractor shall ensure that flash back arrestors conforming to BS:6158 or equivalent are installed on all gas cylinders as well as at the torch end of the gas hose, while in use. All cylinders shall be mounted on trolleys and provided with a closing key. The burner and the hose placed downstream of pressure reducer shall be equipped with




Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- Flash Back Arrester/ Non Return Valve device. The hoses for acetylene and oxygen cylinders must be of different colours. Their connections to cylinders and burners shall be made with a safety collar. At end of work, the cylinders in use shall be closed and hoses depressurized. All welding machines shall have effective earthing. In order to help maintain good housekeeping, and to reduce fire hazard, live electrode bits shall be contained safely and shall not be thrown directly on the ground.
- e) The Contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health for driving of vehicles, handling and erections of materials and equipment. All lifting equipments shall be tested certified for its capacity before use. Adequate and suitable lighting at every work place and approach there to shall be provided by the contractor before starting the actual work/ operation at night. Contractor shall ensure installation of Safe Load Indicator (SLI) on all cranes (while in use) to minimize overloading risk. SLI shall have capability to continuously monitor and display the load on the hook, and automatically compare it with the rated crane capacity at the operating condition of the crane. The system shall also provide visual and audible warnings at set capacity levels to alert the operator in case of violations. The contractor shall be responsible for safe operations of different equipments mobilized and used by him at the workplace like transport vehicles, engines, cranes, mobile ladders, scaffoldings, work tools, etc.
- f) Hazardous and/or toxic material such as solvent coating or thinners shall be stored in appropriate containers.
- g) All hazardous materials shall be labeled with the name of the materials, the hazards associated with its use and necessary precautions to be taken. The work place shall be checked prior to start of activities to identify the location, type and condition of any asbestos materials which could be disturbed during the work. In case asbestos material is detected, usage of appropriate PPEs by all personnel shall be ensured and the matter shall be reported immediately to PMC/ BGL.
- h) Contractor shall ensure that during the performance of the work all hazards to the health of personnel have been identified assessed and eliminated.
- i) Chemical spills shall be contained & cleaned up immediately to prevent further contamination.
- j) All personnel exposed to physical agents such as ionizing or non-ionizing radiation ultraviolet rays or similar other physical agents shall be provided with adequate shielding or protection commensurate with type of exposure involved. For ionizing radiation, requirements of Bhabha Atomic Research Centre (BARC)/ Atomic Energy Regulatory Board (AERB) shall be followed.
- k) Where contract or exposure of hazardous materials could exceed limits or could otherwise have harmful effects, appropriate personal protective equipment such as gloves, goggles, aprons, chemical resistant clothing and respirator shall be used.
- l) Contractor shall ensure the following facilities at work sites:
- I) A Crèche where 10 or more female workers are having children below the age of 6 years.
- II) Reasonable Canteen facilities are made available at appropriate location depending

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- upon site conditions.
- m) Suitable facilities for toilet, drinking water, proper lighting shall be provided at site and labor camps, commensurate with applicable Laws/Legislation.
- n) Contractor shall ensure storage and utilization methodology of material that are not detrimental to the environment. Wherever required Contractor shall ensure that only the environment friendly material are selected.
Emphasize on recycling of waste materials such as metals, plastics, glass, paper, oil & solvents. The waste that cannot be minimized, reused or recovered shall be stored and disposed of safely. In no way, toxic spills shall be allowed to percolate into the ground. The contractor shall not use the empty areas for dumping the wastes.
- o) All person deployed at site shall be knowledgeable of and comply with the environmental laws, rules & regulation relating to the hazardous materials substance and wastes. Contractor shall not dump, release or otherwise discharge or dispose of any such materials without the authorization of BGL/ PMC.
Suitable scaffoldings shall be provided to workmen for all works that cannot be safely done from the ground or from solid construction except such short period work that can be safely done using ladders. When a ladder is used, an extra workman shall be engaged for holding the ladder.
The contractor shall ensure that the scaffolds used during construction activities shall be strong enough to take the designed load. BGL./ PMC reserves the right to ask the contractor to submit certification and or design calculations from his Engineering regarding load carrying capacity of the scaffoldings.
scaffolds shall be inspected by a Scaffolding Inspector of the contractor. He shall paste a GREEN tag on each scaffold found safe and a RED tag on each scaffold found unsafe. Scaffold with GREEN tag only shall be permitted to be used and RED ones shall immediately be removed from the site.
All electrical installations/ connections shall be carried out as per the provisions of latest revision of following codes/standards, in addition to the requirements of Statutory Authorities and IE/ applicable international rules & regulations:
- OISO SID 173 : Fire prevention & protection system for electrical installations
 - SP 30 (BIS) : National Electric Code

All electrical installations shall be approved by the concerned statutory authorities.

The contractor shall meet the following requirements:

- i) Ensure that electrical systems and equipment including tools & tackles used during construction phase are properly selected, installed, used and maintained as per provisions of the latest revision of the Indian Electrical/ applicable international regulations.
- ii) Shall deploy qualified & licensed electricians for proper & safe installation and for regular inspection of construction power distribution system/ points including their earthing. A copy of the license shall be submitted to PMC/ BGL. for records. Availability of at least one competent licensed electrician shall be ensured at site round the clock to attend to the normal/ emergency jobs.
- iii) All switchboards/ welding machines shall be kept in well-ventilated & covered shed. The shed shall be elevated to avoid water logging. No flammable materials shall be used for



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- constructing the shed. Also flammable materials shall not be stored in and around electrical equipment/ switchboard. Adequate clearances and operational space shall be provided around the equipment.
- iv) Fire extinguishers and insulating mats shall be provided in all power distribution centers.
 - v) Temporary electrical equipment shall not be employed in hazardous area without obtaining safety permit.
 - vi) Proper housekeeping shall be done around the electrical installations.
 - vii) All temporary installations shall be tested before energizing, to ensure proper earthing, bonding, suitability of protection system, adequacy of feeders/cables etc.
 - viii) All welders shall use hand gloves irrespective of holder voltage.
 - ix) Multilingual (Hindi, English and local language) caution boards, shock treatment charts and instruction plate containing location of isolation point for incoming supply, name & telephone No. of contact person in emergency shall be provided in substations and near all distribution boards/ local panels.
 - x) Operation of earth leakage device shall be checked regularly by temporarily connecting series test lamp (2 bulbs of equal rating connected in series) between phase and earth.
 - xi) Regular inspection of all installations (at least once in a month)

The following features shall also be ensured for all electrical installations during construction phase by the contractor:

- i) Each installation shall have a main switch with a protective device, installed in an enclosure adjacent to the metering point. The operating height of the main switch shall not exceed 1.5 M. The main switch shall be connected to the point of supply by means of armored cable.
- ii) The outgoing feeders shall be double or triple pole switches with fuses / MCBs. Loads in a three phase circuit shall be balanced as far as possible and load on neutral should not exceed 20% of load in the phase.
- iii) The installation shall be adequately protected against overload, short circuit and earth leakage by the use of suitable protective devices. Fuses wherever used shall be HRC type. Use of rewirable fuses shall be strictly prohibited. The earth leakage device shall have an operating current not exceeding 30 mA.
- iv) All connections to the hand tools/ welding receptacles shall be taken through proper switches, sockets and plugs.
- v) All single phase sockets shall be minimum 3 pin type only. All unused sockets shall be provided with socket caps.
- vi) Only 3 core (P+N+E) overall sheathed flexible cables with minimum conductor size of 1.5 mm² copper shall be used for all single phase hand tools.
- vii) Only metallic distribution boxes with double earthing shall be used at site. No wooden boxes shall be used.
- viii) All power cables shall be terminated with compression type cable glands. Tinned copper lugs shall be used for multistrand wires/ cables.
- ix) Cables shall be free from any insulation damage.
- x) Minimum depth of cable trench shall be 750 mm for MV & control cables and 900 mm



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- for HV cables. These cables shall be laid over a sand layer and covered with sand, brick & soil for ensuring mechanical protection. Cables shall not be laid in waterlogged area as far as practicable. Cable route markers shall be provided at every 25 M of buried trench route. When laid above ground, cables shall be properly cleated or supported on rigid poles of at least 2 M high. Minimum head clearance of 6 meters shall be provided at road crossings.
- xi) Underground road crossings for cables shall be avoided to the extent feasible. In any case no underground power cable shall be allowed to cross the roads without pipe sleeve.
 - xii) All cable joints shall be done with proper jointing kit. No taped /temporary joints shall be used.
 - xiii) An independent earthing facility should preferably be established within the temporary installation premises. All appliances and equipment shall be adequately earthed. In case of armored cables, the armor shall be bonded to the earthing system.
 - xiv) All cables and wire rope used for earth connections shall be terminated through tinned copper lugs.
 - xv) In case of local earthing, earth electrodes shall be buried near the supply point and earth continuity wire shall be connected to local earth plate for further distribution to various appliances. All insulated wires for earth connection shall have insulation of green colour.
 - xvi) Separate core shall be provided for neutral. Earth/ Structures shall not be used as a neutral in any case.
 - xvii) ON/OFF position of all switches shall be clearly designated/ painted for easy isolation in emergency.

The contractor shall identify all operations that can adversely affect the health of its workers and issue & implement mitigation measures.

For surface cleaning operations, sand blasting shall not be permitted even if not explicitly stated elsewhere in the contract.

To eliminate radiation hazard, Tungsten electrodes used for Gas Tungsten Arc Welding shall not contain Thorium.

Appropriate respiratory protective devices shall be used to protect workmen from inhalation of air borne contaminants like silica, asbestos, gases, fumes, etc.


Workmen shall be made aware of correct methods for lifting, carrying, pushing & pulling of heavy loads. Wherever possible, manual handling shall be replaced by mechanical lifting equipments.

For jobs like drilling/ demolishing/ dismantling where noise pollution exceeds the specified limit of 85 decibels, ear muffs shall be provided to the workers.

To avoid upper limb disorders and backaches, Display Screen Equipments' workplace stations shall be carefully designed & used with proper sitting postures. Power driven hand-held tools shall be maintained in good working condition to minimize their vibrating effects and personnel using these tools shall be taught how to operate them safely & how to maintain good circulation in hands.

The contractor shall arrange health checkup for all the workers at the time of induction. Health check may have to be repeated if the nature of duty assigned to him is changed necessitating health check or doubt arises about his wellness. PMC/ BGL. reserve the right to ask the contractor to submit test reports.

Weather Protection

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Contractor shall take appropriate measures to protect workers from severe storms, solar radiations, poisonous gases, dust, etc. by ensuring proper usage of PPEs like

Sun glasses, Sun screen lotions, respirators, dust masks, etc. and rearranging/ planning the construction activities to suit the weather conditions.

Communication

All persons deployed at the work site shall have access to effective means of communication so that any untoward incident can be reported immediately and assistance sought by them.

All health & safety information shall be communicated in a simple & clear language easily understood by the local workforce.

Unsuitable Land Conditions

Contractor shall take appropriate measures and necessary work permits/ clearances if work is to be done in or around marshy areas, river crossings, mountains, monuments, etc.

Under Water Inspection


Contractor shall ensure that boats and other means used for transportation, surveying & investigation works shall be certified seaworthy by a recognized classification society. It shall be equipped with all life saving devices like life jackets, adequate fire protection arrangements and shall possess communication facilities like cellular phones, wireless, walkie-talkie. All divers used for seabed surveys, underwater inspections shall have required authorized license, suitable lifesaving kit. Number of hours of work by divers shall be limited as per regulations. BGL./ PMC shall have the right to inspect the boat and scrutinize documents in this regard.

TOOL BOX MEETING (TBM)

Contractor shall conduct daily TBM with workers prior to start of work and shall maintain proper record of the meeting. A suggested format is given below. The TBM is to be conducted by the immediate supervisor of the workers.

TOOLBOX MEETING RECORDING SHEET

Date & Time			
Subject:			
Presenter: -			
Hazards involved: -			
Precautions to be taken: -			
Sr. No.	Worker's Name	Signature	Section
1.			
2.			
3.			

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

4.		
Remarks, if any		

The topics during TBM shall include

- Hazards related to work assigned on that day and precautions to be taken.
- Any forthcoming HSE hazards/ events/ instruction/ orders, etc.

The above record can be kept in local language, which workers can read. These records shall be made available to PMC/ BGL. whenever demanded.

TRAINING

Contractor shall ensure that all his personnel possess appropriate training to carry out the assigned job safely. The training should be imparted in a language understood by them and should specifically be trained about

- Potential hazards to which they may be exposed at their workplace
- Measures available for prevention and elimination of these hazards

The topics during training shall cover, at the minimum;


- Education about hazards and precautions required
- Emergency and evacuation plan
- HSE requirements
- Firefighting and First-Aid
- Use of PPEs
- Local laws on intoxicating drinks, drugs, smoking in force

Records of the training shall be kept and submitted to PMC/ BGL. whenever demanded.

For offshore and jetty jobs, contractor shall ensure that all personnel deployed have undergone a structured sea survival training including use of lifeboats, basket landing, use of radio communication etc. from an agency acceptable to BGL./ PMC.

INSPECTION

The contractor shall carryout daily HSE inspection and record observations at a central location. These inspection records shall be freely accessible to BGL./ PMC representatives. The contractor shall also assist BGL./ PMC representatives during the


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

HSE inspections conducted by them.

ADDITIONAL SAFETY REQUIREMENTS FOR WORKING INSIDE A RUNNING PLANT

As a minimum, the contractor shall ensure adherence to following safety requirements while working in or in the close vicinity of an operating plant :

- a) Contractor shall obtain permits for Hot work, Cold work, Excavation and Confined Space from BGL. in the prescribed format.
- b) The contractor shall monitor, record and compile list of his workers entering the operational plant/unit each day and ensure & record their return after completing the job.
- c) Contractor's workers and staff members shall use designated entrances and proceed by designated routes to work areas only assigned to them. The workers shall not be allowed to enter units' area, tanks area, pump rooms, etc. without work authorization permit.
- d) Work activities shall be planned in such a way so as to minimize the disruption of other activities being carried out in an operational plant/ unit and activities of other contractors.
- e) The contractor shall submit a list of all chemicals/ toxic substances that are intended to be used at site and shall take prior approval of the BGL..
- f) Specific training on working in a hydrocarbon plant shall be imparted to the work force and mock drills shall be carried out for Rescue operations/ First-Aid measures.
- g) Proper barricading/ cordoning of the operational units/ plants shall be done before starting the construction activities. No unauthorized person shall be allowed to trespass. The height and overall design of the barricading structure shall be finalized in consultation with the BGL. and shall be got approved from the BGL..
- h) Care shall be taken to prevent hitting underground facilities such as electrical cables, hydrocarbon piping during execution of work.
- i) Barricading with water curtain shall be arranged in specific/critical areas where hydrocarbon vapors are likely to be present such as near horton spheres or tanks. Positioning of fire tenders shall also be ensured during execution of critical activities.
- j) Emergency evacuation plan shall be worked out and all workmen shall be apprised about evacuation routes. Mock drill operations may also be conducted.
- k) Flammable gas test shall be conducted prior to any hot work using appropriate measuring instruments. Sewers, drains, vents or any other gas escaping points shall be covered with flame retardant tarpaulin.
- l) Respiratory devices shall be kept handy while working in confined zones where there is a danger of inhalation of poisonous gases. Constant monitoring of presence of Gas/ Hydrocarbon shall be done.
- m) Clearance shall be obtained from all parties before starting hot tapping, patchwork on live lines and work on corroded tank roof.
- n) Positive isolation of line/equipment by blinding for welding/cutting/grinding shall be done. Closing of valve will not be considered sufficient for isolation.
- o) Welding spatters shall be contained properly and in no case shall be allowed to fall on the ground containing oil. Similar care shall be taken during cutting operations.
- p) The vehicles, cranes, engines, etc. shall be fitted with spark arresters on the exhaust

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- pipe and got it approved from Safety Department of the BGL..
- q) Plant air should not be used to clean any part of the body or clothing or use to blow off dirt on the floor.
 - r) Gas detectors should be installed in gas leakage prone areas as per requirement of BGL.'s plant operation personnel.
 - s) Experienced full time safety personnel shall be exclusively deployed to monitor safety aspects in running plants.

HSE PROMOTION

The contractor shall encourage his workforce to promote HSE efforts at workplace by way of organizing workshops/ seminars/ training programmes, celebrating HSE awareness weeks & National Safety Day, conducting quizzes & essay competitions, distributing pamphlets, posters & material on HSE, providing incentives for maintaining good HSE practices and granting bonus for completing the job without any lost time accident.

4.0 DETAILS OF HSE MANAGEMENT SYSTEM BY CONTRACTOR

4.1 On Award of Contract

The Contractor shall prior to start of work submit his Health, Safety and Environment Manual of procedure and HSE Plans for approval by BGL./ PMC. The Contractor shall participate in the pre-start meeting with BGL./ PMC to finalize HSE plans including the following.

- Job procedure to be followed by Contractor for activities covering Handling of equipment Scaffolding, Electric Installation, describing the risks involved, actions to be taken and methodology for monitoring each.
- Organizations structure along with responsibility and authority records/ reports etc. on HSE activities.

4.2 During job execution

4.2.1 Implement approved Health, Safety and Environment management procedure including but not limited to as brought our under para 3.0. Contractor shall also ensure to:

- Arrange workmen compensation insurance, registration under ESI Act, third party liability insurance etc. as applicable.
- Arrange all HSE permits before start of activities (as applicable) like her work, confined space, work at heights, storage of Chemicals/explosives materials and its use and implement all precautions mentioned therein
- Submit timely the completed check list on HSE activities, Monthly HSE report, accident report, investigation report, etc. as per BGL/ PMC requirements. Compliance of instructions on HSE shall be done by Contractor and informed urgently to BGL/ PMC.
- Ensure that resident Engineers/Site-In-Charge of the Contractor shall amend all the Safety Committee/HSE meeting arranged by BGL./ PMC only in case of his absence from site, a seconds senior most person shall be nominated by him in advance and



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**


VOLUME II OF
II

- communicated to BGL/ PMC.
- Display at site office and work locations caution boards, list of hospitals for emergency services available.
- Provided posters, banners, for safe working to promote safety consciousness
- Carryout audits/inspection at sub-Contractor work as per approved HSE documents & submit the reports for BGL/ PMC review.
- Assist in HSE audits by BGL/ PMC and submit compliance report.
- Generate & submit HSE records/ reports as per HSE Plan.
- Appraise BGL./ PMC on HSE activities at site.

5.0 RECORDS

At the minimum, the contractor shall maintain/ submit HSE records in the following reporting formats:


1. Monthly HSE Checklist cum compliance report HSE-1
2. Accident/ Incident Report HSE-2
3. Supplementary Accident/ Incident Investigation report HSE-3
4. Near Miss Incident Report HSE-4
5. Monthly HSE Report HSE-5
6. Permit for working at height HSE-6
7. Permit for working in confined space HSE-7
8. Permit for radiation work HSE-8
9. Permit for demolishing/ dismantling HSE-9

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

A. IS CODES ON HSE

ANNEXURE-A

- SP:53 Safety code for the use, Care and protection of hand operated tools.
 IS: 818 Code of practice for safety and health requirements in electric and gas welding and cutting operations
 IS: 1179 Eye and Face precautions during welding, equipment etc.
 IS: 1860 Safety requirements for use, care and protection of abrasive grinding wheels.
 IS: 1989(Part-I & II) Leather safety boots and shoes IS: 2925 Industrial Safety Helmets
 IS: 3016 Code of practice for fire safety precautions in welding and cutting operations.
 IS: 3043 Code of practice for earthing.
 IS: 3764 Code of safety for excavation work
 IS: 3786 Methods for computation of frequency and severity rates for industrial injuries and classification of industrial accidents.
 IS: 3996 Safety Code of scaffolds and ladders.
 IS: 4082 Recommendation on stacking and storage of construction materials and components at site.
 IS: 4770 Rubber gloves for electrical purposes
 IS: 5121 Safety code for piling and other deep foundations
 IS: 5216 (Part-I) Recommendations on Safety procedures and practices in electrical works IS: 5557 Industrial and Safety rubber lined boots.
 IS: 5983 Eye protectors
 IS:6519 Selection, care and repair of Safety footwear
 IS: 6994 (Part-I) Industrial Safety Gloves (Leather & Cotton Gloves) IS: 7293 Safety Code for working with construction Machinery
 IS: 8519 Guide for selection of industrial safety equipment for body protection IS: 9167 Ear protectors
 IS: 11006 Flash back arrestor (Flame arrestor)
 IS:11016 General and safety requirements for machine tools and their operation
 IS: 11057 Specification for Industrial safety nets
 IS: 11226 Leather safety footwear having direct moulded rubber sole


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- IS: 11972 Code of practice for safety precaution to be taken when entering a sewerage system
IS: 13367 Code of practice-safe use of cranes
IS: 13416 Recommendations for preventive measures against hazards at working place

B. INTERNATIONAL STANDARDS ON HSE

- Safety Glasses : ANSI Z 87.1, ANSI ZZ 87.1, AS 1337, BS 2092, BS 1542, BS 679, DIN 4646/ 58211
Safety Shoes : ANSI Z 41.1, AS 2210, EN 345
Hand Gloves : BS 1651
Ear Muffs : BS 6344, ANSI S 31.9
Hard Hat : ANSI Z 89.1/ 89.2, AS 1808, BS 5240, DIN 4840
Goggles : ANSI Z 87.1

- Face Shield : ANSI Z 89.1
Breathing Apparatus : BS 4667, NIOSH
Welding & Cutting : ANSI Z 49.1
Safe handling of: P-1 (Compressed Gas Association
compressed Gases in cylinders 1235 Jefferson Davis Highway, Arlington VA 22202
USA)

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

DETAILS OF FIRST AID BOX

ANNEXURE-B

SL. NO	DESCRIPTION	QUANTITY
1.	Small size Roller Bandages, 1 inch wide (Finger Dressing small)	6 Pcs.
2.	Medium size Roller Bandages, 2 inch wide (Hand and Foot Dressing)	6 Pcs.
3.	Large size Roller Bandages, 4 inch wide (Body Dressing Large)	6 Pcs.
4.	Large size Burn Dressing (Burn Dressing Large)	4 Pkts.
5.	Cotton wool (20 gms packing)	4 Pkts.
6.	Antiseptic Solution Dettol (100 ml.) or Savlon	1 Bottle
7.	Mercurochrome Solution (100 ml.) 2% in water	1 Bottle
8.	Ammonia Solution (20 ml.)	1 Bottle
9.	A Pair of Scissors	1 Piece
10.	Adhesive Plaster (1.25 cm x 5 m)	1 Spool
11.	Eye pads in Separate Sealed Packet	4 Pcs.
12.	Tourniquet	1 No.
13.	Safety Pins	1 Dozen
14.	Tinc. Iodine/ Betadine (100 ml.)	1 Bottles
15.	Ointment for burns (Burnol 20 gms.)	1 Bottle
16.	Polythene Wash cup for washing eyes	1 No.
17.	Potassium Permanganate (20 gms.)	1 Pkt.
18.	Tinc. Benzoine (100 ml.)	1 Bottle
19.	Triangular Bandages	2 Nos.
20.	Band Aid Dressing	5 Pcs.
21.	Iodex/ Moov (25 gms.)	1 Bottle
22.	Tongue Depressor	1 No.
23.	Boric Acid Powder (20 gms.)	2 Pkt.
24.	Sodium Bicarbonate (20 gms.)	1 Pkt.
25.	Dressing Powder (Nebasulf) (10 gms.)	1 Bottle



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

ANNEXURE D

Indicative List of Statutory Acts & Rules Relating to HSE

- The Indian Explosives Act and Rules
- The Motor Vehicle Act and Central Motor Vehicle Rules
- The Factories Act and concerned Factory Rules
- The Petroleum Act and Petroleum Rules
- The Workmen Compensation Act

- The Gas Cylinder Rules and the Static & Mobile Pressure Vessels Rules.

- The Indian Electricity Act and Rules


- The Indian Boiler Act and Regulations

- The Water (Prevention & Control & Pollution) Act

- The Water (Prevention & Control of Pollution) Cess Act

- The Mines & Minerals (Regulation & Development) Act

- The Air (Prevention & Control of Pollution) Act

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- The Atomic Energy Act
- The Radiation Protection Rules
- The Indian Fisheries Act
- The Indian Forest Act
- The Wild Life (Protection) Act
- The Environment (Protection) Act and Rules
- The Hazardous Wastes (Management & Handling) Rules
- The Manufacturing, Storage & import of Hazardous Chemicals Rules
- The Public Liability Act
- The Building and Other Construction Workers (Regulation of Employment and Condition of service) Act
- Other statutory acts Like EPF, ESIS, Minimum Wage Act.

ANNEXURE E

CONSTRUCTION HAZARDS, THEIR EFFECTS & PREVENTIVE MEASURES

ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES
(A) EXCAVATION Pit Excavation	●Falling into pit	●Personal injury	Provide guard rails/barricade with warning signal. Provide at least two entries/exits. Provide escape ladders.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

up to 3.0m	<ul style="list-style-type: none"> •Earth Collapse 	Suffocation/ Breathlessness <ul style="list-style-type: none"> •Buried 	Provide suitable size of shoring and strutting, if required. Keep soil heaps away from the edge equivalent to 1.5m or depth of pit whichever is more. Don't allow vehicles to operate too close to excavated areas. Maintain at least 2m distance from edge of cut. Maintain sufficient angle of repose. Provide slope not less than 1:1 and suitable bench of 0.5m width at every 1.5m depth of excavation in all soils except hard rock. Battering/benching the sides.
	Contact with buried electric cables <ul style="list-style-type: none"> • Gas/ Oil Pipelines 	<ul style="list-style-type: none"> •Electrocution Explosion 	Obtain permission from competent authorities, prior to excavation, if required. Locate the position of buried utilities by referring to plant drawings. Start digging manually to locate the exact position of buried utilities and thereafter use mechanical means
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES
Pit Excavation beyond 3.0m	Same as above plus Flooding due to excessive rain/ underground water	Can cause drowning situation	Prevent ingress of water Provide ring <ul style="list-style-type: none"> • buoys Identify and provide suitable size dewatering pump or well point system
	Digging in the vicinity of existing Building/ Structure	Building/ Structure may collapse <ul style="list-style-type: none"> •Loss of health &wealth 	Obtain prior approval of excavation method from local authorities Use under-pining method Construct retaining wall side by side
	Movement of vehicles/ equipments close to the edge of cut.	May cause cave-in or slides Persons may get buried	Barricade the excavated area with proper lighting arrangements Maintain at least 2m distance from edge of cut and use stop block to prevent over-run. Strengthen shoring and strutting
Narrow deep excavations for pipelines, etc.	Same as above plus Frequent cave-in or slides	May cause severe injuries or prove fatal	Battering/benching of sides Provide escape ladders
	Flooding due to Hydrostatic testing	May arise drowning situation	<ul style="list-style-type: none"> •Same as above plus •Bail out accumulated water • Maintain adequate ventilation
Rock excavation by blasting	Improper handling of explosives	<ul style="list-style-type: none"> • May prove fatal 	Ensure proper storage, handling & carrying of explosives by trained personnel. Comply with the applicable explosive acts & rules.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES
	Uncontrolled explosion	May cause severe injuries or prove fatal	Allow only authorized persons to perform blasting operations. ● Smoking and open flames are to be strictly prohibited.
	Scattering of stone pieces in atmosphere	● Can hurt people	Use PPE like goggles, face mask, helmets etc.
Rock excavating by blasting (Contd)	Entrapping of persons/ animals.	May cause severe injuries or prove fatal	Barricade the area with red flags and blow siren before blasting.
	● Misfire	May explode suddenly	Do not return to site for at least 20 minutes or unless announced safe by designated person.
Piling Work	Failure of pile- driving equipment	● Can hurt people	Inspect Piling rigs and pulley blocks before the beginning of each shift.
	Noise pollution	Can cause deafness and psychological imbalance	Use personal protective equipments like ear plugs, muffs, etc.
	●Extruding rods / casing	● Can hurt people	● Barricade the area an install sign boards Provide first-aid
	Working in the vicinity of 'Live- Electricity'	Can cause electrocution/ asphyxiation	Keep sufficient distance from Live- Electricity as per IS code. Shut off the supply, if possible Provide artificial/rescue breathing to he injured.
(B) CONCRETING	Air pollution by cement	May affect Respiratory System	Wear respirators or cover mouth and nose with wet cloth.
	Handling of ingredients	Hand s may get injured	Use gloves and other PPE.
	Protruding reinforcement rods.	Feet may get injured	● Use Safety shoes. Provide platform above reinforcement for movement of workers.
	Earthing of electrical mixers,	Can cause electrocution/ asphyxiation	Ensure earthing of equipments and proper functioning of
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES
	vibrators, etc. not done		electrical circuit before commencement of work.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	Falling of materials from height	Persons may get injured	<ul style="list-style-type: none"> Use hard hats Remove surplus material immediately from work place Ensure lighting arrangements during night hours.
	Continuous pouring by same gang	Cause tiredness of workers and may lead to accident.	<ul style="list-style-type: none"> Insist on shift pattern Provide adequate rest to workers between subsequent pours.

	Revolving or concrete mixer/ vibrators	Parts of body or clothes may get entrapped.	Allow only mixers with hopper Provide safety cages around moving motors Ensure proper mechanical locking of vibrator
Super-structure	Same as above plus Deflection in props or shuttering material	Shuttering/ props may collapse and prove fatal	Avoid excessive stacking on shuttering material Check the design and strength of shuttering material before commencement of work Rectify immediately the deflection noted during concreting
	Passage to work place	Improperly tied and designed props/ planks may collapse	Ensure the stability and strength of passage before commencement of work Do not overload and under the passage.
(C) REINFORCEMENT	Curtailment and binding of rods	Persons may get injured	Use PPE like gloves, shoes, helmets, etc. Avoid usage of shift tools
	Carrying of rods for short distance/ at	Workers may injure their hands and shoulders	Provide suitable pads on shoulders and use safety
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES
	heights		gloves. Tie up rods in easily liftable bundles Ensure proper staging.
	Checking of clear distance/ cover with hands	Rods may cut or injure the finger	Use measuring devices tape, measuring rods, etc.
	Hitting projected rods and standing on cantilever rods	Persons may get injured and fall down	Use safety shoes and avoid standing unnecessarily on cantilever rods Avoid wearing loose clothes
	Falling of material from height	<ul style="list-style-type: none"> May prove fatal 	<ul style="list-style-type: none"> Use helmets Provide safety nets



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	Transportation of rods by trucks / trailers	Protruded rods may hit the persons	Use red flags/lights at the ends Do not protrude the rods in front of or by the side of driver's cabin. Do not extend the rods 1/3rd of deck length or 1.5 m which is less
(D) WELDING AND GAS CUTTING	Welding radiates invisible ultraviolet and infrared rays	Radiation can damage eyes and skin.	Use specified shielding devices and other PPE of correct specifications Avoid throated tungsten electrodes for GTAW.
	Improper placement of oxygen and acetylene cylinders	Explosion may occur	Move out any leaking cylinder Keep cylinder in vertical position Use trolley for transportation of cylinders and chain them Use flash back arrestors
	<ul style="list-style-type: none"> Leakage / cuts in hoses 	<ul style="list-style-type: none"> May cause fire 	Purge regulators immediately and then turn <ul style="list-style-type: none"> off Never use grease or
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES

			oil on oxygen line connections and copper fittings on acetylene lines Inspect regularly gas carrying hoses Always use red hose for acetylene & other fuel gases and black for oxygen.
	Opening-up of cylinder	Cylinder may burst	Always stand back from the regulator while opening the cylinder Turn valve slowly to avoid bursting Cover the lug terminals to prevent short circuiting.
	Welding of tanks, container or pipes storing flammable liquids	Explosion may occur	Empty & purge them before welding Never attach the ground cable to tanks, container or pipe storing flammable liquids Never use LPG for gas cutting
(E) RADIOGRAPH Y	<ul style="list-style-type: none"> Ionizing Radiation 	Radiations may react with the skin and can cause cancer, skin irritation, dermatitis, etc.	Ensure safety regulations as per BARC/AERB before commencement of job. Cordon off the area and install Radiation warning symbols Restrict the entry of unauthorized persons Wear appropriate PPE and film badges issued by BARC/AERB



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	Transportation and Storage of Radiography source	<ul style="list-style-type: none"> Same as above 	<p>Never touch or handle radiography source with hands</p> <ul style="list-style-type: none"> Store radiography source inside a pit in an exclusive isolated storage room with lock and key arrangement. The pit should be approved by BARC/AERB <p>Radiography source should never be carried either in passenger bus or in a passenger compartment of trains.</p> <p>BARC/AERB have to be informed before source movement.</p> <p>Permission from Director General of Civil Aviation is required for booking radio isotopes with airlines</p>
	Loss of Radio isotope	<ul style="list-style-type: none"> Same as above 	<p>Try to locate with the help of Survey Meter.</p> <ul style="list-style-type: none"> Inform BARC/AERB(*) <p>Atomic Energy Regulatory Board (AERB), Bhabha Atomic Research Centre (BARC) Anushaktinagar, Mumbai –400 094</p>

F) ELECTRICAL INSTALLATION AND USAGE	Short circuiting	Can cause Electrocutation or Fire	<p>Use rubberized hand gloves and other PPE Don't lay wires under carpets, mats or doorways.</p> <p>Allow only licensed electricians to perform on electrical facilities Use one socket for one appliance</p> <p>Ensure usage of only fully insulated wires or cables</p> <p>Don't place bare wire ends in a socket</p> <p>Ensure earthing of machineries and equipments</p> <p>Do not use damaged cords and avoid temporary connections</p> <p>Use spark- proof/flame proof type field distribution boxes.</p> <p>Do not allow open/bare connections Provide all connections through ELCB</p> <p>Protect electrical cables/ equipment's from water and naked flames Check all connections before energizing</p>
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**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	Overloading of Electrical System	<ul style="list-style-type: none"> Bursting of system can occur which leads to fire 	<p>Display voltage and current ratings prominently with 'Dahger' signs.</p> <p>Ensure approved cable size, voltage grade and type. Switch off the electrical utilities when not in use.</p> <p>Do not allow unauthorized connections.</p> <p>Ensure proper grid wise distribution of Power.</p>
	Improper laying of overhead and underground transmission lines/ cables	Can cause electrocution and prove fatal	Do not lay unarmored cable directly on ground, wall, roof of trees Maintain at least 3m distance from HT cables All temporary cables should be laid at least 750 mm below ground on 100 mm
			fine sand overlying by brick soling Provide proper sleeves at crossings/ intersections Provide cable route markers indicating the type and depth of cables at intervals not exceeding 30m and at the diversions / termination.

(G) FIRE PREVENTION AND PROTECTION	Small fires can become big ones and may spread to the surrounding areas	Cause burn injuries and may prove fatal.	<p>In case a fire breaks out, press fire alarm system and shout "Fire, Fire"</p> <p>Keep buckets full of sand & water/fire extinguishing equipment near hazardous locations</p> <ul style="list-style-type: none"> Confine smoking to 'Smoking Zones' only Train people for using specific type of fire equipments under different classes of fire Keep fire doors/ shutters, passages and exit doors unobstructed Maintain good house keeping and first-aid boxes (for detail refer Annex-2) Don't obstruct access to Fire extinguishers Do not use elevators for evacuation during fire Maintain lightning arrestors for elevated structures Stop all electrical motors with internal combustion. Move the vehicles from dangerous locations. Remove the load hanging from the crane booms. Remain out of the danger areas
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**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	Improper selection of Fire Extinguisher	It may not extinguish the fire	Ensure usage of correct fire extinguisher meant for the specified fire (for details refer Appendix-C) Do not attempt to extinguish Oil and electric fires with water. Use foam cylinders/CO ₂ /sand or earth.
	Improper storage of highly inflammable substances	<ul style="list-style-type: none"> • Same as above 	Maintain safe distance of flammable substances from source of ignition Restrict the distribution of flammable materials to only min. necessary amount Construct specifically designed fuel storage facilities Keep chemicals in cool and dry place away from hat. Ensure adequate ventilation Before welding operation, remove or shield the flammable material properly Store flammable materials in stable racks, correctly labeled preferably with catchments trays. Wipe off the spills immediately
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES
	Short circuiting of electrical system	<ul style="list-style-type: none"> • Same as above • Can cause Electrocutation 	Don't lay wires under carpets, mats or door ways Use one socket for one appliance Use only fully insulated wires or cables Do not allow open/bare connections Provide all connections through ELCB Ensure earthing of machineries and equipments
(H) VEHICULAR MOVEMENT	Crossing the Speed Limits (Rash driving)	<ul style="list-style-type: none"> • Personal injury 	Obey speed limits and traffic rules strictly Always expect the unexpected and be a defensive drive Use sat belts/helmets Blow horn at intersections and during overtaking operations. Maintain the vehicle in good condition Do not overtake on curves, bridges and slopes

	Adverse weather condition	<ul style="list-style-type: none"> • Same as above 	Read the road ahead and ride to the left Keep the wind screen and lights clean <ul style="list-style-type: none"> • Do not turn at speed Recognize the hazard, understand the defense and act correctly in time.
	Consuming alcohol before and during he	<ul style="list-style-type: none"> • Same as above 	Alcohol and driving do not mix well. Either choose
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES



Bhagyanagar Gas Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	driving operation		<p>alcohol or driving. If you have a choice between hitting a fixed object or an oncoming vehicle, hit the fixed object Quit the steering at once and become a passenger. Otherwise take sufficient rest and then drive. Do not force the driver to drive fast and round the clock Do not day dram while driving</p>
	<ul style="list-style-type: none"> Falling objects / Mechanical failure 	<ul style="list-style-type: none"> May prove fatal 	<p>Ensure effective braking system, adequate visibility for the drives, reverse warning alarm. Proper maintenance of the vehicle as per manufacturer instructions</p>
(I) PROOF TESTING (HYDROSTATIC/ PNEUMATIC TESTING	<p>Bursting of piping Collapse of tanks Tanks flying off</p>	<p>May cause injury and prove fatal</p>	<p>Prepare test procedure & obtain CONSULTANT/ BGL. s approval Provide separate gauge for pressurizing pump and piping/equipment Check the calibration status of all pressure gauges, dead weight testers and temperature recorders Take dial readings at suitable defined intervals and ensure most of them fall between 40-60% of the gauge scale range Provide safety relief valve (set at</p>
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

			<p>pressure slightly higher than test pressure) while testing with air/nitrogen Ensure necessary precautions, stepwise increase in pressure, tightening of bolts/ nuts, grouting, etc. before and during testing Keep the vents open before opening any valve while draining out of water used for hydro testing of tanks Pneumatic testing involves the hazard of released energy stored in compressed gas. Specific care must therefore be taken to minimize the chance of brittle failure during a pneumatic leak test. Test temperature is important in this regard and must be considered when the designer chooses the material of construction A pressure relief device shall be provided, having a set pressure not higher than the test pressure plus the lesser of 345 KPa (50 psi) or 10% of the test pressure. The gas used as test fluid, if not air, shall be nonflammable and nontoxic.</p>
(J) WORKING AT HEIGHTS	Person can fall down	May sustain severe injuries or	Provide guard rails/barricade at the
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES
		prove fatal	<p>work place Use PPE like safety belts, full body harness, life line, helmets, safety shoes, etc. Obtain a permit before starting the work at height above 3 meters Fall arrest systems like safety nets, etc. must be installed Provide adequate working space (min. 0.6 m) Tie/weld working platform with fixed support Use roof top walk ladder while working on a slopping roofs Avoid movement on beams</p>
		<ul style="list-style-type: none"> May hit the scrap / material stacked at the ground or in between 	<p>Keep the work place neat and clean Remove the scrap immediately</p>



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	Material can fall down	May hit the workers working at lower levels and prove fatal.	<ul style="list-style-type: none"> Same as above plus Do not throw or drop material or equipment from height All tools to be carried in a toolkit bags or on working uniform Remove scrap from the planks Ensure wearing of helmet by the workers at low level
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	Overloading of lifting equipments	Can cause electrocution and fire	Safe lifting capacity of derricks and winches written on them shall be got verified. The max safe working load shall be marked on all lifting equipments <ul style="list-style-type: none"> Check the weight of columns and other heavy items painted on them and accordingly decide about the crane capacity, boom and angle of erection Allow only trained operators and riggers during crane operation
	Overhead electrical wires	Can cause electrocution and fire	Do not allow boom or other parts of crane to come within 3 m reach of overhead HT cables Hook and load being lifted shall preferably remain in full visibility of crane operator.
(M) SCAFFOLDING, FORMWORK AND LADDERS	Person can fall down	Person may sustain severe injuries and prove fatal	Provide guard rails for working at height Face ladder while climbing and use both hands Ladders shall extend about 1m above landing for easy access and tying up purpose Do not place ladders against movable objects and maintain base at ¼ unit of the working length of the ladder Suspended scaffolds shall not be less than 500 mm wide and tied properly with ropes No loose planks shall be allowed Use PPE, like helmets, safety shoes, etc.
	Failure of scaffolding material	<ul style="list-style-type: none"> Same as above 	Inspect visually all scaffolding materials for stability and anchoring with permanent structures. Design scaffolding
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

			for max. load carrying capacity Scaffolding planks shall not be less than 50x250 mm full thickness lumber or equivalent. These shall be cleared or secured and must extend over the end supports by at least 150mm and not more than 300 mm Don't overload the scaffolds Do not splice short ladders to make a longer one. Vertical ladders shall not exceed 6m.
	Material can fall down	Persons working at lower level gets injured.	Remove excess material and scrap immediately Carry the tools in a tool-kit bag ●only Provide safety nets

(N) STRUCTURAL WORKS	Personal negligence and danger of fall	Can cause injury or casualty	Do not take rest inside rooms built for welding machines or electrical distribution system Avoid walking on beams at height Wear helmet with chin strap and safety belts when working at height Use hand gloves and goggles during grinding operations Cover or mark the sharp and projected edges Do not stand within the operating radius of cranes
	● Lifting / slipping of	● Same as above	Do not stand under the lifted load
ACTIVITY	TYPE OF HAZARD	EFFECT OF	PREVENTIVE MEASURES
	material		Stack properly all the materials. Avoid slippage during handling Control longer pieces lifted up by cranes from both ends Remove loose materials from height Ensure tightening of all nuts and bolts
(O) PIPELINE WORKS	Erection/ lowering failure	● Can cause injury	Do not stand under the lifted Load Do not allow any person to come within the radii of the side boom handling pipes Check the load carrying capacity of the lifting tools and tackles Indicators ● Use safe Load PPEs ● Use appropriate

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

	<ul style="list-style-type: none"> Other 	<ul style="list-style-type: none"> Same as above 	<p>Wear gum boots in marshy areas Allow only one person to perform signaling operations while lowering of pipes Provide night caps on pipes Provide end covers on pipes for stoppage of pigs while testing/cleaning operations.</p>
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FORMAT NO. : HSE-1, REV. 0

HSE CHECKLIST CUM COMPLIANCE REPORT (1/6)

Project: Date :
 Inspection By:..... Contractor :
 Report No. : Job No :
 Frequency : Fortnightly

Note: write A wherever the item is not applicable

SL. NO.	ITEM	YES	NO	REMARKS	ACTION
1	HOUSEKEEPING				
a)	Waste containers provided and used				
b)	Sanitary facilities adequate and clean				
c)	Passageways and Walkways clear				
d)	General neatness of working areas				
e)	Others				
2	PERSONNEL PROTECTIVE EQUIPMENT				
a)	Goggles; Shields				
b)	Face protection				
c)	Hearing protection				
d)	Safety shoes				
e)	Hand protection				
f)	Respiratory Masks etc.				
g)	Safety Belts				
h)	Safety Helmet/Hard Hat				
l)	Others				
3	EXCAVATIONS/OPENINGS				
a)	Openings properly covered or barricaded				
b)	Excavations shored				
c)	Excavations barricaded				
d)	Overnight lighting provided				
e)	Others				
4	WELDING & GAS CUTTING				
a)	Gas cylinders chained upright				
b)	Cables and hoses not obstructing				
c)	Screens or shields used				
d)	Flammable materials protected				
e)	Fire extinguisher(s) accessible				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

f)	Others				
5	SCAFFOLDING				
a)	Fully decked platforms				
b)	Guard and intermediate rails in place				
c)	Toe boards in place				
d)	Adequate shoring				
e)	Adequate access				
f)	Others				
6	LADDERS				
a)	Extension side rails 1m above				
b)	Top of landing				
c)	Properly secured				
d)	Angle + 70 from horizontal				
e)	Others				
7	HOISTS, CRANES AND DERRICKS				
a)	Condition of cables and sheaves OK				
b)	Condition of slings, chains, hooks and eyes OK				
c)	Inspection and maintenance logs maintained				
d)	Outriggers used				
e)	Signs/barricades provided				
f)	Signals observed and understood				
g)	Qualified operators				
h)	Others				
8	MACHINERY, TOOLS AND EQUIPMENT				
a)	Proper instruction				
b)	Safety devices				
c)	Proper cords				
d)	Inspection and maintenance				
e)	Others				
9	VEHICLE AND TRAFFIC				
a)	Rules and regulations observed				
b)	Inspection and maintenance				
c)	Licensed drivers				
d)	Others				
10	TEMPORARY FACILITIES				
a)	Emergency instructions posted				
b)	Fire extinguishers provided				
c)	Fire-aid equipment available				
d)	Secured against storm damage				
e)	General neatness				
f)	In accordance with electrical requirements				
g)	Others				
11	FIRE PREVENTION				
a)	Personnel instructed				
b)	Fire extinguishers checked				
c)	No smoking in Prohibited Areas				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

d)	Hydrants Clear				
e)	Others				
12	ELECTRICAL				
a)	Use of 3-core armored cables				
b)	Usage of 'All insulated' or 'double insulated' electrical tools				
c)	All electrical connection are routed through ELCB				
d)	Natural Earthing at the source of power (main DB)				
e)	Continuity and tightness of earth conductor				
f)	Covering of junction boxes, panels and other energized wiring places				
g)	Ground fault circuit interrupters provided				
h)	Prevention of tripping hazards				
i)	Others				


13	HANDLING AND STORAGE OF MATERIALS				
a)	Properly stored or stacked				
b)	Passageways clear				
c)	Others				
14	FLAMMABLE GASES AND LIQUIDS				
a)	Containers clearly identified				
b)	Proper storage				
c)	Fire extinguishers nearby				
d)	Others				
15	WORKING AT HEIGHT				
a)	Erection plan and work permit obtained				
b)	Safety nets				
c)	Full body harness and lanyards; chute lines				
d)	Health Check record available for workers going				
e)	Others				
16	CONFINED SPACE				
a)	Work permit obtained				
b)	Test for toxic gas and sufficient availability of oxygen conducted				
c)	At least one person outside the confined space for monitoring deputed				
d)	Availability of sufficient means of entry, exit and ventilation				
e)	Fire extinguishers and first-aid facility ensured				
f)	Lighting provision made by using 24V lamps				
g)	Proper usage of PPEs ensured				
17	RADIOGRAPHY				
a)	Proper storage and handling of source as per BARC/ AREB guidelines				
b)	Working permit obtained				
c)	Cordoning of the area done				
d)	Use of appropriate PPE's ensured				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

e)	Proper training to workers/supervisors imparted				
f)	Minimum occupancy of workplace ensured				
18	HEALTH CHECKS				
a)	Workers medically examined and found to fit for working : i) At heights ii) In confined space.				
b)	Availability of First-aid facilities				
c)	Proper sanitation at site, office and labor camps				
d)	Arrangement of medical facilities				
e)	Measures for dealing with illness				
f)	Availability of Portable drinking water for workmen &				
g)	Provision of crèches for children				
h)	Stand by vehicle available for evacuation of				
19	ENVIRONMENT				
a)	Chemical and other effluents properly disposed				
b)	Cleaning liquid of pipes disposed off properly				
c)	Seawater used for hydro-testing disposed off as per agreed procedure				
d)	Lubricant Waste/Engine oils properly disposed				
e)	Waste from Canteen, offices, sanitation etc. disposed properly				
f)	Disposal of surplus earth, stripping materials, oily rags and combustible materials done				
g)	Green belt protection				

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
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FORMAT NO. : HSE-2, REV. 0

ACCIDENT/ INCIDENT REPORT

(To be submitted by Contractor after every Accident/ Incident within 24 hours)

Report No: _____ Date: _____

Name of Site:- _____ CONTRACTOR: _____

Type of Accident/ Incident : Fatal Other Lost Time Non Loss Time First-Aid case

Name Of The Injured Age


Father's Name SUB-CONTRACTOR

M/s..... Date & Time of Accident.....

LOCATION

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

NATURE OF INJURY/DAMAGE

MEDICAL AID PROVIDED/ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES (IF APPLICABLE)

DATE:

SIGNATURE OF CONTRACTOR WITH SEAL

To : BGL. 1 COPY
: RCM/SITE-IN-CHARGE, PMC 3 COPIES

Divisional Head (Constn.) through RCM Project Manager PMC, through RCM

FORMAT NO. : HSE-3, REV. 0

SUPPLEMENTARY ACCIDENT/ INCIDENT INVESTIGATION REPORT

Project: _____
Name of Work : _____
Contractor: _____

Supplementary to Report No: _____ (Copy enclosed)

Site: _____

Date: _____

Work Order/ LOI No. : _____



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

FORMAT NO. : HSE-4, REV. 0

NEAR MISS INCIDENT-- SUGGESTED PROFORMA

Name of Site :
Report No:

Date :

Name of Work :
Contractor :

INCIDENT REPORTED BY :

DATE & TIME OF INCIDENT

: LOCATION :



Bhagyanagar Gas Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF II

ITEM	UPTO PREVIOUS MONTH	THIS MONTH	CUMU-LATIVE
a) Average number of Staff & Workmen (average daily headcount, not man days)			
b) Manhours Worked			
c) Number of HSE meeting organized at site			
d) Number of HSE awareness programmes conducted at site			
e) Number of Lost Time Accidents (LTA)	Fatal Other LTA		
f) Number of Loss time Injuries (LTI)	Fatalities Other LTI		
g) Number of Loss Time Accidents			
h) Number of First Aid Cases			
i) Number of Near Miss Incidents			
j) Man-days lost due to accidents			
k) LTA Free Manhours i.e. Number of LTA free manhours from the Lst LTA			
l) Compensation cases raised with Insurance			
m) Compensation case resolved and paid to workmen			
n) Whether workmen compensation policy taken	Y/N		
o) Whether workmen compensation policy valid	Y/N		
p) Whether workmen registered under ESI Act	Y/N		
Remark			

DATE:

Safety Officer /Resident Engineer
(Signature and Name)

To : BGL.
: RCM/, PMC (2 COPIES)


FORMAT NO. : HSE-6, REV. 0

PERMIT FOR WORKING AT HEIGHT (ABOVE 2 METER)

Project Site : Sr.No.:.....
Name of the work:Date:.....
Name of Contractor

Nature of Work

Total No. of Workers.....

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Exact Location of work.....
Duration of work: From..... to.....

The following items have been checked and compliance shall be ensured during the currency of the permit:

Sl.	ITEM	DONE	NOT REQD.
1.	Equipment/Work Area inspected		
2.	Considered hazard from other routine/non-routine operations and concerned person alerted		
3.	ELCB provided		
4.	Proper lighting provided		
5.	Area cordoned off.		
6.	Precautions against public traffic taken		
7.	Sound Scaffolding provided		
8.	Adequate protected Platform provided		
9.	Access and Exit to the area (Ladder properly fixed)		
10.	Floor Openings covered		
11.	Safety Net provided		
12.	Heath check of personnel		

- A. Following personal protective equipment are provided (mark) and used as relevant Safety helmet/Gloves/Goggles/Shoes/Face Shield/Life Line/Safety Belt/Safety Harness.
- B. This permit shall be available at the work site at all times.
- C. Permit shall be issued for maximum one week only (Monday to Sunday).
- D. This permit shall be applicable in non-operational areas.
- E. After completion of the work, used permits shall be preserved for record purposes.
- F. Additional precautions, if any

Permission is granted to work (See overleaf) = Yes/No

Name of Contractor Supervisor
(Initiator)
Authority)


Name of Contractor Safety Officer
(Issuing



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

 <p data-bbox="232 310 391 365">Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
----------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

GRANT OF PERMIT AND EXTENSIONS

Sl. No.	Validity Period From _____ To	Work time From __.Hrs. To ____Hrs.	Initiator (Supervisor of Contractor)	Issuing Authority (Safety Officer) of Contractor	Verification by CONSULTANT with date

Additional safety instructions, if any.



Bhagyanagar Gas Limited

**RATE CONTRACT FOR COMPOSITE WORKS
 (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
 OF DIFFERENT TYPE OF CNG STATIONS IN BGL
 AUTHORIZED GA'S
 Bid Document No. BGL/636/2024-25**

VOLUME II OF II


FORMAT NO. : HSE-7, REV. 0

CONFINED SPACE ENTRY PERMIT

Project Site.....
 Sr.No.....
 Name of Work.....
 Date.....
 Name of Contractor.....
 Nature of Work.....
 Exact Location of Work.....

Safety Requirements: POSITIVE ISOLATION OF THE VESSEL IS MANDATORY

(A) Has the equipment been ?			
Y	NR	Y	NR
isolated from power/ steam/ air isolated from liquid or gases depressurized &/or drained blanked/ blinded / disconnected		water flushed &/or steamed Manways open & ventilated cont. inset gas flow arranged adequately cooled	radiation sources removed Proper lighting provided
(B) Expected Residual Hazards			
Y	NR	Y	NR
lack of O ₂ corrosive chemicals Heat/ stream / frost		combustible gas / liquid pyrophoric iron / scales high humidity	H ₂ S/ toxic gases electricity/ static ionizing radiation
(C) Protective Measures			
Y	NR	Y	NR
gloves protective clothing Grounded air educator/ blower/ AC Firefighting arrangements		ear plug/ muff dust/ gas/ airline mask attendant with SCBA/ air mask safety harness & lifeline	goggles/ face shield personal gas alarm rescue equipment / team communication equipment

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Authorization/ Renewal (It is safe to enter the confirmed space)


Date	No. of Persons allowed	Name of Persons allowed	Signature		Time	Signature Workman
			Contractor's Supervisor	Contractor's Safety Officer	From To	

Permit Closure :

- (A) Entry was closed stopped will continue on
- (B) Site left in a safe condition House keeping done
- (C) Multi lock removed key transferred
Ensured all men have come out

Manways barricaded

Remarks, if any :

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

FORMAT NO. : HSE-8, REV. 0

RADIATION WORK PERMIT

Project :	Sr. No.
Name of the Work:	Date.
Name of Contractor:	Job.No.:
Location of work	
Source Strength	
Cordoned distance (m) :	
Name of Radiographing agency	

Approved by BGL./ PMC


The following items have been checked & compliance shall be ensured during currency of the permit :

S. No.	Item Description	Done
1.	Safety regulations as per BARC/AERB ensured while source in use/ in transit & during storage.	<input type="checkbox"/>
2.	Area cordoned off.	<input type="checkbox"/>
3.	Lighting arrangements for working during nights ensured.	<input type="checkbox"/>
4.	Warning signs/ flash lights installed.	<input type="checkbox"/>
5.	Cold work permit taken (if applicable)	<input type="checkbox"/>
6.	PPEs like film badges, dosimeters used.	<input type="checkbox"/>

Additional precautions, if any

(Radiography Agency s BARC/
AREB authorized Supervisor)

(Contractor s Safety Officer)

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Permission is granted.

Permit is valid from _____AM/PM_____Date to _____AM/PM_____Date

(Signature of permit issuing authority)

Name :

Designation :


Date :

Permit renewal :

Permit extended upto		Additional precautions	Sign of issuing authority with
Date	Time		

Work completed/ stopped/ area cleared at _____Hrs. of Date _____

(Sign of permit issuing authority) Name :

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

FORMAT NO. : HSE-9, REV. 0

RADIATION WORK PERMIT


Project : Sr. No.:
Name of the work : Date:
Name of Contractor : Job No. :
Name of Contractor :

Line No./ Equipment No. /Structure to be dismantled :

Location details of dismantaling/ demolition with sketch: (Clearly indicate the area)

The following items have been checked & compliance shall be ensured during currency of the permit :

S. No.	Item Description	Done	Not Applicable
1.	Services like power, gas supply, water, etc. disconnected.		
2.	Dismantling/ Demolishing method reviewed & approved.		
3.	Usage of appropriate PPEs ensured.		
4.	Precautions taken for neighboring structures		
5.	First-Aid arrangements made		
6.	Fire fighting arrangements ensured		
7.	Precautions taken for blasting		

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

(Contractor Supervisor)
Permission is granted.


(Contractor Safety Officer)

(Permit issuing authority) Name :
Date :

Completion Report :
Dismantling/ Demolishing is completed on _____ Date at _____ Hrs. Materials/ debris
transported to identified location
Tagging completed (as applicable)
Services like power, gas supply, water, etc. restored

(Permit issuing authority)

**CONDITIONS FOR ISSUE AND
RECONCILIATION OF
MATERIAL
(ANNEXURE 8 to SCC)**


 <p>Bhagyanagar Gas Limited</p>	<p style="text-align: center;">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p style="text-align: center;">VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------

ANNEXURE-8 TO SCC

1.0 CONDITIONS FOR ISSUE OF MATERIALS

Whenever any material is issued by Owner, following conditions for issue of material in addition to other conditions specified in the contract shall be applicable:

- 1.1 Necessary indents will have to be raised by the Contractor as per procedure laid down by the Engineer-in-Charge from time to time, when he requires the above material for incorporation in permanent works.
- 1.2 Materials will be issued only for permanent works and not for temporary works, enabling works etc. unless specifically approved by the Engineer-in-Charge and the same shall not be taken into account for the purpose of materials reconciliation.
- 1.3 The Contractor shall bear all other cost including lifting, carting from issue points to work site/Contractor's store, custody and handling etc. and return of surplus/serviceable scrap materials to Owner's storage points to be designated by the Engineer-in-Charge etc. No separate payment for such expenditure will be made.
- 1.4 No material shall be allowed to be taken outside the plant without a gate pass.
- 1.5 The Contractor shall be responsible for proper storage, preservation and watch & ward of the materials.
- 1.6 RETURN OF UNUSED MATERIAL

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------


- 1.6.1 All unused/scrap materials shall be the property of the Owner and shall be returned in good and acceptable condition size wise, category wise by the Contractor at his own cost to Owner's Store(s).
- 1.6.2 No credit will be given to the Contractor for return of scrap. The Contractor should quote the rates accordingly.
- 1.6.3 In case the Contractor fails to return unused/scrap materials, then recovery for such quantity of materials, not returned by the Contractor shall be affected at following penal rates from the Contractor's bills or from any other dues of the Contractor to the Owner. Contractor shall make his own arrangements for weighing the off cuts to be returned to Owner's stores.
- 1.6.4 Penal Rates for non return of material

Sl. No.	Material	Penal Rates
(a)	Penal rate for non return of accountable scrap	Issue Rate + 25% or Landed Rate + 25% (in case issue rate are not indicated in the contract)
(b)	Penal rates for non return of Unused material/excess scrap	Twice the Issue Rates or Twice the Landed Rates (in case Issue Rates are not indicated in the Contract)

- NOTE: 1) Landed Rate shall be arrived from the latest Purchase Order of respective material received at site by Owner.
- 2) In case different penal rates have been indicated in the Contract (based on Project requirement), the same will supersede the above rates.

2.0 PIPING MATERIALS

- 2.1 All pipes shall be issued in available lengths/shapes and no claims for extra payments on account of issue of non-standard length & shape will be entertained. Pipes shall be issued on linear measurement basis. All valves, flanges, fittings etc. shall be issued on number(s) basis. Contractor shall store the materials in such a way so as to avoid mixing of different types of material and shall maintain complete identification and traceability at all times.
- 2.2 The scrap allowance for pipes issued by the Owner shall be 3% (2½% accountable + ½% non accountable) of the actual consumption as incorporated in the works.
- 2.3 All pipes in length of 2 m and above shall be considered as serviceable material provided the material is in good and acceptable condition and has clear identification and number and test certificates). Pipes in lengths less than 2 m shall be treated as scrap.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

2.4 For the non account of pipes drawn by the Contractor over and above the actual consumption as determined by the Engineer-in-Charge, plus 3% (2½% accountable + ½% non accountable) thereof to cover the scrap allowance, recovery at penal rate shall be effected from the Contractor's bill(s) or from any other dues of the Contractor to the Owner.

2.5 All unused/scrap pipes, valves, flanges, forged fitting like elbows, reducers tees shall be returned by the Contractor category wise duly cleaned, greased and spec. marked at his own cost to Owner's stores. In case the Contractor fails to do so then recovery for such quantity of pipes not returned by the Contractor at the penal rates shall be affected from the Contractor's bill(s) or from any other dues of the Contractor to the Owner.

3.0 EQUIPMENTS

Various equipment/materials intended for the installation will be received by Owner in unpacked, skid mounted crated, packed or loose condition and will be stored in the warehouses designated places of issue to the point of installation and return all packing materials like steel

All materials supplied by the Owner shall be duly protected by the Contractor at his own cost with appropriate preservative like primer, lacquer coating, grease etc. as required.


4.0 CABLES

4.1 Appropriation of cables shall be done as follows:

4.1.1 All the surplus and serviceable cables out of the cables quantity(ies) issued by the Owner to the Contractor shall be returned by the Contractor to the Owner's store in good condition and as directed by the Engineer-in-Charge.

4.1.2 The Contractor shall be allowed a cutting/wastage allowance of 1.5% for power cables and 3% for the control cables. This cutting/wastage allowance shall be computed on the length of cables actually laid, measured and accepted.

4.1.3 All cables being returned to store should carry Aluminum sheet tags indicating the size & type of cable. Cables of less than 15 meters length will be termed as scrap. Cables of lengths 15M and above shall be termed as serviceable material & shall be returned size wise and category wise to the Owner's store in wooden drums. Cables of serviceable length being returned to stores in drum(s) shall be accepted only after Megger value continuity test and physical measurement is carried out by the Contractor to the satisfaction of Engineer-in-Charge. Empty cable drums and major packing material (as decided by Engineer-in- in charge) shall be

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Owner's property and shall be returned to owner's store/ designated place without any additional cost.

4.1.4 While carrying out material appropriation with the Contractor, the above points will be taken into account. All serviceable materials returned by the Contractor (size wise & category wise) shall be deducted from the quantity(ies) issued to the Contractor for the respective sizes. Scrap generated for power cable and control cable shall also be

4.1.5 Material appropriation shall be done & allowable scrap quantity calculated. The wastage generated by the Contractor in excess of the allowable percentage shall be charged at the penal rates.

5.0 LINE PIPES

5.1 All bare line pipes as per Line Pipe specifications shall be issued on linear measurement basis. The line pipes shall be issued in available lengths and shapes and no claim for extra payment on account of issue of non-standard length and shape will be entertained. Contractor shall store and maintain the line pipes in proper manner to avoid mixing of different classes of pipes. Contractor shall maintain complete identification and traceability at all times. All cut pieces when returned to Owner's storage points after bevelling, shall be considered as serviceable material provided:

5.1.1 Corrosion Protection Coating is intact.

5.1.2 authenticated with hard stamp of the authorized inspector as per approved procedure. All cut pieces of pipes measuring less than 2 M will be treated as wastage/scrap.

5.2 For the purpose of accounting of line pipes, following allowances shall be permitted:

- a) Unaccountable wastage 0.1%
- b) Scrap (All cut pieces of pipes measuring 0.25% less than 2 Meter)
- c) Serviceable materials (All cut pieces of pipe 0.5% measuring 2 Meter and above)
Scrap shall be accounted at actual as per site assessment subject to maximum limits as stated above.

The percentage allowance shall be accounted on the basis of pipe book chainage for main pipeline

5.2.1 Material appropriation shall be done & allowable scrap quantity calculated. The wastage generated by the Contractor in excess of the allowable percentage shall be charged at the penal rates as given in the contract.



Bhagyanagar Gas
Limited


**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**HIRING/RECOVERY RATE FOR DEPLOYMENT OF MANPOWER
(Annexure- 9 of Special Condition of Contract)**

HIRING / RECOVERY RATE FOR DEPLOYMENT OF MANPOWER

1. The labour rates are “ all inclusive “ these rates include but are not limited to all payroll costs and allowances, payroll taxes, fringe benefits, protective and/or special clothing, construction supplies required for work of a nature included in

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

this contract, overhead, profit, insurance, transportation and travel time.

2. The rates are inclusive of providing hand tools and consumables such as electrodes, filler wire, gases, grinding wheels where the concerned category of labour is expected to use in execution of the job but exclusive of all major equipment and machineries.

3. The normal time labour rates shall apply for all hours worked up to eight (8) hours in a day and overtime rates shall apply for all hours worked in excess of eight (8) hours in one working day, Sunday and Public Holidays. The payment for part of the day shall be made on prorata basis.

SR NO.	CLASSIFICATION PERSONNEL	RATE PER DAY OF NORMAL HOURS	RATE PER HOUR FOR OVER TIME, SUNDAY & HOLIDAY
		IN RS.	IN RS.
1	FOREMAN	2475	540
2	SURVEYOR	1750	385
3	SUPERVISOR	2750	600
4	ENGINEER	3500	775
5	SAFETY OFFICER/SUPERVISOR	2750	600
6	GAS CUTTER	1155	250
7	GRINDER	1155	250
8	BRICK MASON	800	175
9	STONE MASON	800	175
10	STRUCTURAL WELDER	1650	360
11	QUALIFIED ARC WELDER- AUTOMATIC	2250	490
12	QUALIFIED ARC WELDER- MANUAL	1750	385
13	WATCHMAN/HELPER	650	140
14	CIVIL LABOUR (UNSKILLED LABOUR)	650	140
15	PIPELINE FITTER	1000	220
16	STRUCTURAL FITTER	850	185
17	COATER	850	185
18	MECHANIC	850	185
19	SITE EQUIPMENT/MACHINE OPERATOR	850	185
20	HEAVY MACHINE OPERATOR	1000	220



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

21	HEAVY DUTY DRIVER	1000	220
22	ELECTRICIAN	1000	220
23	FABRICATOR	1000	220
24	CARPENTER	800	175
25	PLUMBER	800	175
26	PAINTER	800	175
27	CABLE JOINTER	800	175
28	FUSION OPERATION/JOINTER	850	185
29	INSTRUMENTATION TECHNICIAN	850	185
30	INSULATOR	700	150
31	RIGGER	750	165
32	BHISTI (WATER MAN)	650	145
33	DOCUMENT CONTROLLER	1000	220
34	ACCOUNT OFFICER	1500	330
35	STORE KEEPER/INCHARGE	1000	220

(SIGNATURE OF BIDDER)

NOTES:-

1. Rates are final and Tenderer is to sign only without deviation.
2. In case of foreign bidder, conversion rate applicable on one day prior to price bid opening date published by the State Bank of India will be considered.
3. The recovery rates shall be the rates provided above plus 20% (twenty percent).




Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**EQUIPMENT HIRING/RECOVERY RATES
(Annexure - 10 of Special Condition of Contract)**

 <p>Bhagyanagar Gas Limited</p>	RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25	VOLUME II OF II
------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

EQUIPMENT HOURLY RENTAL RATES FOR EXTRA WORKS

Sl. No.	Equipment	HIRING / RECOVERY RATES (IN INR) (Per Day): 8 Hrs INCLUDING CONSUMABLES & FUEL
1.	Excavator / Back Hoe-Ex 280 / 300 & Above or Equivalent	10,000
2.	Excavator / Back Hoe-Ex 200 & Above or Equivalent	8,000
3.	Pipe Layer/Side Boom – 70 T & Above Capacity	10,000
4.	Pipe Layer/Side Boom – 60 T & Above Capacity	9,500
5.	Pipe Layer/Side Boom – 40 T & Above Capacity	8,500
6.	Pipe Bending Machine	7,500
7.	Dozer with Ripper – D7/D6 or Equivalent	6,500
8.	DG Welding Machines	1,800
9.	Semi Auto Welding Machines	2,500
10.	Dozer with Ripper – D8 or Equivalent	10,000
11.	Hydra (upto 10 MT)	4,000
12.	Hydra (above 10 MT - upto 25 MT)	5,000
13.	Hydra (above 25 MT)	5,800
14.	Horizontal Auger Boring Machine with Rock breaking tool	4,500
15.	Pipe Clamp (Pneumatic/Hydraulic) – Internal	1,500
16.	Tyre Mounted Cranes (above 10 and upto 30 MT)	7,500
17.	Tyre Mounted Cranes (above 30 and upto 75 MT)	15,000
18.	Tyre Mounted Cranes (above 75 MT)	25,000
19.	X-Ray M/C – Internal Crawler	2,500
20.	X-Ray M/C – External	2,500
21.	Gamma Source	750
22.	Water Lifting Pump (400 m3/hr. & above)	900
23.	Filling Pumps (400 TO 1000 M3/HR)	950
24.	Pressurization Pump – Motorized	3,500
25.	Induction/Resistance Heating Equipment or LPG Multi Torch.	4,000
26.	Air Compressor – (300CFM)	4,000
27.	Air Compressor – (450/600/800 CFM)	4,200
28.	Air Compressor – (1000-1500 CFM)	4,500



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

29.	D.G. Sets : 62.5 KVA to 200 KVA (inclusive of generators)	5,000
30.	Blast Cleaning Machine	500
31.	Pipe Trailers (FB / Semi Low Bed)	7,000

32.	Mono drill crawler mounted	3,500
33.	Hand drill(pneumatic)for rock blasting	2,500
34.	Rock breaker attachment	4,000
35.	Dozing Pump	500
36.	Bevel Cutting Machine –Manual	750
37.	UT Machine with operator	1,500
38.	Dewatering Pump	1,500
39.	Holiday Detector Unit	500
40.	Dead WT Tester	500
41.	Dumper / Tipper	4,000
42.	Pipe locator	500
43.	Pipe Clamp – External	600
44.	Pipe Trailer for Coated Line Pipe	7,500
45.	Rock Breaking Machine with Excavator	10,000
46.	Grinding machine	250
47.	Gas cutting set with cylinders	750
48.	Trucks (upto 9 T) with driver	5,000
49.	Car/Jeep with driver (5 Seater)	2,000
50.	Car/Jeep with driver (7 Seater)	2,500
51.	Tractor with trolley	2,000
52.	Tripod with 5 Tons Chain Pulley Block	400
53.	Pneumatic Drill (Tractor mounted for blasting) with Compressor	5,000
54.	JCB Excavator	8,000
55.	JCB Excavator with rock breaking tool	12,000
56.	Moling machine (Manual)	3,000
57.	Moling machine (Machine)	5,000
58.	Fusion jointing Machine	5,000
59.	Concrete mixer 0.25 to 0.40 Cum with hopper or as required.	1,000
HDD equipments		
60.	HDD Rig with all Equipments & Accessories (Cap upto 50 T) (Soft Strata)	20,000



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

61.	HDD Rig with all Equipments & Accessories (Cap upto 50 T) (Rock Strata)	25,000
62.	HDD Rig with all Equipments & Accessories (Cap above 50 T and upto 100 T) (Soft Strata)	30,000
63.	HDD Rig with all Equipments & Accessories (Cap above 50 T and upto 100 T) (Rock Strata)	40,000
64.	HDD Rig with all Equipments & Accessories (Cap above 100 T and upto 200 T) (Soft Strata)	80,000
65.	HDD Rig with all Equipments & Accessories (Cap above 100 T and upto 200 T (Rock Strata)	100,000
66.	HDD Rig with all Equipments & Accessories (Cap above 200 T and upto 350T) (Soft Strata)	115,000
67.	HDD Rig with all Equipments & Accessories (Cap above 200 T and upto 350T (Rock Strata)	140,000
68.	HDD Rig with all Equipments & Accessories (Cap above 350 T) (Soft Strata)	150,000
69.	HDD Rig with all Equipments & Accessories (Cap above 350 T) (Rock Strata)	180,000

NOTES: -

1. Rates are inclusive of operators / drivers / Fuel /POL and consumables.
2. Rates are inclusive of overheads & profit.
3. In case of foreign bidder, conversion rate applicable on one day prior to price bid opening date published by the State Bank of India will be considered.
4. The recovery rates shall be the rates provided above plus 20% (twenty percent).
5. Hiring rates of above equipments are for one shift (i.e. 8 Hrs). Hiring rates for two shifts i.e. 16 hrs are 1.25 times of above rates & hiring rates for three shifts i.e. 24 hrs are 1.5 times of above Rates.
6. Notes for HDD equipment: -
 - a. Rates are inclusive of operators / drivers / Fuel /POL and consumables.
 - b. Rates are inclusive of overheads & profit.
 - c. In case of foreign bidder, conversion rate applicable on one day prior to price bid opening date published by the State Bank of India will be considered.
 - d. The recovery rates shall be the rates provided above plus 20% (twenty percent).

(SIGNATURE OF BIDDER)



Bhagyanagar Gas
Limited


**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Annexure- I

STANDARD CONDITIONS OF SCC: PART I

Not Applicable for this tender

 <p>Bhagyanagar Gas Limited</p>	<p style="text-align: center;">RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p style="text-align: center;">VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------

Annexure-II


STANDARD CONDITIONS OF SCC: PART II Compliances under various Labour Laws

The Contractor has to fully comply with all applicable Labour Laws and Regulations passed, modified and notified from time to time by the Central, State and Local Government agencies/authorities. Specific attention of the Contractor is drawn to the following obligations amongst others:

1. The Minimum Wages Act, 1948, Payment of Wages Act, 1936 and Payment of Bonus Act 1965 or
The Code on Wages, 2019 (after it comes into force)
 - 1.1. **Minimum Wages:**
 - a. During the tenure of the contract, the Contractor must ensure the payment of minimum wages, as notified by the Central Government or State Government whichever is higher, as per the provisions of the Minimum Wages Act, 1948 / Code on Wages, 2019 (after it comes into force).
 - b. **Wage period and monthly wages:** Wage period shall be monthly and wages for a month shall be calculated by multiplying daily rate of Minimum Wages by 26. The monthly wages include the wages of the weekly days of rest as applicable to the office/establishment of BGL.

Deduction in case of any days of absence other than weekly days of rest shall be calculated using the following formula:

Deduction for absence = days of absence x applicable wage rate

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

1.2. Payment of Wages:

- a. The Contractor shall disburse monthly wages through e-banking / digital mode through cashless transaction only, and avoid illegitimate deductions and maintain records /returns as prescribed. The Contractor shall be solely responsible for the payment of wages and other dues to the resources, if any, deployed by him latest by 7th day of the subsequent month as per the provisions of the Payment of Wages Act, 1936 / as applicable under Code on Wages, 2019 (after it comes into force) in the presence of Engineer In-charge (EIC) or authorized representative of BGL. After disbursement of wages, the representative of the Contractor and EIC/ authorised representative of BGL have to certify the payment of wages to the resources and sign the Wage Register - Form B (under The Ease of Compliance to Maintain Registers under various Labour Laws Rules, 2017) / FORM-I of Code on Wages, 2019 (after it comes into force) with specific seal detailing name/designation/Company.

1.3. Payment of Bonus:

Contractor shall ensure payment of bonus as per the provisions of the Payment of Bonus Act, 1965 / Code on Wages, 2019 (after it comes into force). Present minimum rate of payment of Bonus as per the Payment of Bonus Act, 1965 is 8.33% of minimum wages per month or 8.33%

of Rs.7,000/- per month whichever is higher. The rate shall be subject to amendments made from time to time to the legislation.


Payment of Bonus / ex-gratia shall be made preferably before Deepawali festival falling after the end of relevant financial year(s) and the balance payment at the time of closure of contract.

For service contracts, the payment towards the bonus/ex-gratia (made on yearly basis) shall be released / reimbursed to the contractor, after submission of proof of payment. No reimbursement shall however be applicable in works contract.

2. Leaves/ Leave with wages/ Holiday:

The Contractor shall comply with all the applicable leave Rules including leave with wages in terms of applicable labour legislations i.e. Factories Act, 1948 / Shops & Establishment Act/ Industrial Establishment (national & festival holidays, casual & sick leave) Act, 1965.

The Contractor shall extend the leave with wages and maintain the Register of Leave pertaining to the resource deployed. The payment towards un-availed leave, as per the Factories Act, 1948 / Shops & Establishment Act, shall be settled with the resource at the time of closure of the contract or separation of resource from the contract by the contractor.

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

- i. As per the **Factories Act, 1948 (if applicable)**:-Annual Leave with Wages @ 01 day for every 20 days of work performed by him in the previous calendar year becomes due.
- ii. As per the **Shops & Establishment Act (if applicable)** : Privilege Leave not less than 15 days and Sickness/Casual Leave not less than 12 days (this provision may vary from state to state).
- iii. As per the **Industrial Establishment (National & Festival Holidays, Casual & Sick Leave) Act, 1965 / Negotiable Instrument Act 1881 / Shops & Establishment Act (as applicable)**:
 - (a) three national holidays of one whole day each on the 26th January, 15th August and 2nd October
 - (b) five other holidays on any of the festivals specified in the - Schedule appended to this Act.
 - (c) Every worker shall in each calendar year, be allowed by the employer 07 casual leave and 14 sick leave in such manner and on such conditions as may be prescribed (This provision may vary from state to state).


3. The Employees Provident Fund & Miscellaneous Provisions Act 1952

- a) The Contractor shall have independent PF code no. with the RPFC as required under the
- b) The Contractor has to ensure compliance (as per prevailing rates) and extend benefits under the employee provident Fund Scheme 1952, the employees Pension Scheme 1995 & the employee Deposit Linked Insurance scheme, 1976 to the resources deployed by him.
- c) The Contractor is required to submit copies of separate e-Challans / ECR alongwith proof of payment/receipt in respect of resources engaged through this contract only, on monthly basis. **Common challans would not be acceptable in BGL.** The Contractor should submit copies of previous months EPF e-Challans /ECR along with current month's bill. The TRRN.

No. of the ECR would be verified online from EPFO portal by the Engineer-in-charge to confirm the status of payment and names of the resources deployed.

- d) **PF is mandatory irrespective of the number of resources deployed** by the Contractor under this contract. PF membership and deposit of PF contribution is also mandatory even if the wage payment to the resource is exceeding the prescribed monthly wage ceiling (i.e. Rs. 15,000/-) under the employees' PF & Misc. provisions Act, 1952 and in such case the liability of the Contractor towards PF contribution shall be limited to the prescribed monthly wage ceiling notified from time to time (i.e. Rs. 15,000/- currently).

4. The Employees' state Insurance Act. 1948 (If applicable and as per

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

prevailing rates)

- a) The Contractor shall have his own ESI code No. allotted by employees State Insurance Corporation (ESIC) as required under the state insurance act 1948.
- b) The Contractor has to arrange Smart Cards (i.e. ESI Identity Card) /e-Pehchan Card for the resource(s) engaged by him from the Corporation.

5. The Employees Compensation Act 1923 (wherever applicable)

In case, the work place is out of the notified coverage area under ESIC i.e. ESIC is not implemented in the area or in case of excluded employees under ESIC, the Contractor is required to take Employee Compensation / Workmen Compensation Policy from IRDAI approved Insurance Company taking into consideration the maximum compensation liability as per provisions of employees as per provisions of employees ' compensation Act,1923. It must be ensured that the contractor/contracting firm should extend coverage to the contract workers through Employee Compensation Policy, to meet the Compensation Liability under Employee Compensation Act 1923 along with Medi-claim Floater Policy with a coverage of Rs. 3 Lakhs per resource covering his/her spouse and two children.

6. Group Personal Accident Insurance Policy


The Contractor is required to take a Group Personal Accident Insurance Policy with coverage of Rs. 5 Lakhs (covering death, permanent disability + partial disability) per resource for the entire period of contract covering all resources deployed under the contract.

7. The Payment of Gratuity Act, 1972

In case of Death or permanent disablement of a resource during execution of work under the contract, the Contractor has to pay the Gratuity as per the provision under the Payment of Gratuity Act, 1972 to the nominee(s) of the resource as per the details maintained in the duly signed Nomination Form maintained by the Contractor. The proof of disbursement may be submitted to the EIC for claiming reimbursement of amount paid towards death Gratuity from BGL.


8. The Contract Labour (R&A) Act, 1970

- a) The Contractor is required to obtain Labour license under the provisions of the Contract Labour (R&A) Act, 1970 from the office of Licensing Officer, Central Labour Authority, Ministry of Labour and Employment, Govt. of India having jurisdiction of the Region.
- b) The Contractor shall discharge obligations as provided under the Contract Labour (R&A) Act, 1970 rules and regulations framed under the same and enforced from time to time.
- c) The Contractor shall ensure regular and effective supervision and control over the

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

resources deployed for which a supervisor / representative of the Contractor should be available at all the times for giving suitable direction for undertaking the Contractual Obligations.

- d) The Contractor is solely responsible for payment of wages to each resource deployed by him and such wages shall be paid before the expiry of such period as may be prescribed.
 - e) It shall be the duty of the Contractor to ensure the disbursement of wages to resource(s) through e-banking/digital mode. In case the resource does not have a bank account, the disbursement of wages may be made in cash in the presence of the Engineer-in-charge / authorized representative of BGL initially and Contractor shall simultaneously arrange for opening the bank account of each contract labour deployed by him.
 - f) In case, the Contractor fails to make payment of wages and deposit of PF contribution within the prescribed period or makes short payment of wages / short deposit of PF contribution, **it shall be treated as FAILURE and action as per the provisions of General Conditions of Contract shall be taken.** Further, BGL as Principal Employer, will make payment of wages in full or the unpaid balance due, as the case may be, to the resource(s) deployed by the Contractor and deposit the PF contribution with PF authorities. Such amounts will be recovered from the Contractor either by deduction from any amount payable to the Contractor under any contract or as a debt payable by the Contractor.
9. The contractor is required to comply with all applicable labour laws and regulations including, but not limited to the following:
- a) The Factories Act, 1948 / The Shops & Establishment Act, 1948 (whichever is applicable)
 - b) The Maternity Benefit Act, 1961
 - c) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1979 & Building and Other Construction Workers Welfare Cess Act, 1996
 - d) The Inter State Migrant Workmen (RECS) Act 1979 (if applicable)
 - e) Contract Labour (R&A) Act-1970
 - f) Provident Fund & Misc. Provisions Act- 1952
 - g) State Insurance Act-1948
 - h) Compensation Act, 1923
 - i) Payment of Gratuity Act, 1972
 - j) Minimum of Wages Act, 1948
 - k) The Payment of Wages Act, 1936
 - l) The Payment of Bonus Act, 1965


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Annexure- III

STANDARD CONDITIONS OF SCC: PART III

Responsibilities of the Contractor

1. The Contractor shall be solely responsible and indemnify BGL against all charges, dues, claim etc. arising out of the disputes relating to the dues and employment of resources, if any, deployed by him.
2. The Contractor shall indemnify BGL against all losses or damages, if any, caused to it on account of acts of the resource(s) deployed by him.
3. The Contractor shall indemnify BGL from all claims, demands, actions, cost and charges etc. brought by any court, competent authority / statutory authorities against BGL.
4. The Contractor shall also indemnify BGL for any action brought against him for violation, non-compliance of any act, rules & regulation of center / state / local statutory authorities.
5. All resources deployed by the Contractor are deemed to be on the rolls of the Contractor.
6. Age: No resource below the age of 18 years shall be deployed by the contractor for the execution of the contract. However, maximum age of resources deployed under the contract would be 60 years. (In case of Security and Fire & Safety Services, no resource below the age of 18 years shall be deployed by the contractor for the execution of the contract. However, in view of nature of business operation and nature of duty, for efficacy & efficiency purpose, resources will be deployed up to the age of 58 years. However, the age limit can be relaxed for a further period of two (02) years up to the age of 60 years if the contract worker is competent, efficient and medically fit i.e. physically fit with good health, good eye sight without any disease. The contractor has to produce Medical Fitness Certificate, to this effect, against such contract workers if deployed beyond 58 years.)
7. **Appointment/Nomination of supervisor:**
As a part of the contract, the Contractor is required to appoint/nominate a supervisor (s) who will supervise, control and give directions to the resource(s) for discharging the contractual obligations. Accordingly, the Contractor has to give in writing the name and contact details of the supervisor (s) to the EIC. A copy of the same is also to be sent to HR In-charge and Security In-charge for records.
8. A copy of the Letter of Acceptance (LOA) should be submitted to the Security Department by the Contractor / his representative or supervisor for facilitating the movement of resource(s) including machine & materials involved in the contract.
9. The resources to be deputed/ deployed by the Contractor shall observe all security, fire and safety rules of BGL while at the site/work. All existing and

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

amended safety / fire rules of BGL are to be followed at the work site by the Contractor and his deployed resource(s).

10. Personal Protective Equipment / Safety Kit and Liveries: Contractor shall ensure adequate supply of personal protective equipment / Safety Kit and Liveries as mentioned in the Scope of Work to all such resources deployed.
11. In case of accident, injury or death caused to the resource(s) while executing the Work under the contract, the Contractor shall be solely responsible for payment of adequate compensation, insurance money etc. to the next kith & kin of injured / diseased. Contractor shall indemnify BGL from such liabilities.
12. The Contractor shall not deploy any resource suffering from any contagious or infectious disease. The Contractor shall get the deployed resource(s) examined from a civil Govt. Doctor .
13. No resource(s) or representatives of Contractor (including Contractor) be allowed to consume alcoholic drinks or any narcotics within the premises of BGL (including Plant, Office and Residential etc.). If found under the influence of above, the Contractor shall immediately replace that resource(s) with intimation to the EIC.
14. While engaging the resources, the Contractor is required to make efforts to provide an opportunity to candidates with experience of apprentice training in BGL under the provisions of the Apprentices Act, 1961.
15. The Contractor is required to maintain all Registers and other records in an office within the premises of BGL or at a place within a radius of three kilometers.
16. Contractor shall provide proper Employment cards (FORM XII) for the resource to be deployed by him, duly signed by the Contractor or authorized person on behalf of Contractor.
17. **Gate/ Entry Pass or Authorization:**
Entry to the premises of BGL is restricted and is subject to appropriate entry authorization in the prescribed format of a Gate Pass or any other entry authorization w.r.t police verification as per instruction of security department from time to time . Similarly, entry for material / equipments/ tools / tackles etc. is restricted & subjected to entry authorization by security department.
18. The Contractor shall issue Identity cards in his firm name to the resource deployed.
19. Discipline of the resource(s) during discharge of duties must be regulated by the Contractor himself or by his representative.
20. **Police verification**
 - a) The Contractor (including his sub-Contractors/Petty Contractors etc, if allowed) will undertake police verification in respect of the resources(s) engaged by him in



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

- BGL's premises. Such verification will have to be carried out from concerned police station of their permanent place of residence/present place of residence.
- b) Further, the Contractor is advised not to deploy any resource having past criminal record in the establishment/premises of BGL under this contract awarded to him.
 - c) In the event of violation of above clauses at (a) and (b), the Contractor will be solely responsible for the same.
 - d) If any such resource(s) having criminal record is deployed by the Contractor in the premises of BGL and has come to the notice of BGL at any point of time, the Contractor shall immediately replace that resource(s), failing which that particular resource(s) of the Contractor will not be allowed to enter into the premises of BGL.
21. While confirming to any of these conditions, the Contractor must ensure that all applicable Laws of State regarding labour, their welfare, conduct etc. are complied.
 22. The contractor shall ensure the KYC of contract workers in EPFO portal at all time during the period of contract and submit a proof of the same to the Engineer-in-charge.
 23. The contractor shall ensure that the nomination of contract workers deployed by him under the said contract is duly updated in the EPFO Portal.



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Annexure- IV

STANDARD CONDITIONS OF SCC: PART IV

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Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

Annexure-V

**STANDARD CONDITIONS OF SCC: PART V
Records and Registers**




**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

1. **Maintenance of records and registers**

The Contractor is required to maintain statutory records and registers for applicable labour laws as prescribed under the following rules:

 - a) Ease of Compliance to Maintain Registers under the various Labour Laws, 2017
 - b) Rationalization of Forms and Reports under Certain Labour Laws Rules, 2017
 - c) Labour Codes (after they are made effective by Government of India)
2. The Contractor has to maintain the following (but not limited to) Registers/ Forms/ Reports / Returns at all times:
 - a) Employee Register in FORM A (to be replaced by FORM IV of Code on Wages-2019 after it comes into force)
 - b) Wage Register in FORM B (to be replaced by Register of Wages, Overtime, Fine, Deduction for damage and Loss in FORM I of Code on Wages-2019 after it comes into force)
 - c) Register of Loan / Recoveries in FORM C
 - d) Attendance Register in FORM D
 - e) Register of rest/leave/leave wages in FORM E
 - f) Copies of Wage Slips in FORM XIX (to be replaced by FORM V of Code on Wages-2019, after it comes into force)
 - g) Copies of Employment Card in FORM XII
3. **Documents to be submitted by the Contractor to EIC at various stages during the currency of the contract**
 - a) **Immediately after issuance/receiving of Letter of Acceptance (LOA)**
 - i. Details as required for issuance of FORM - VII (Notice of Commencement of Work)
 - ii. Application for issuance of FORM III (Form of Certificate by Principal Employer) for obtaining Labour License from Licensing Authority for engaging 20 or more resources.
 - iii. Copy of FORM - VI (License) before commencement of work if 20 or more resources are engaged.
 - iv. Copy of Provident Fund Registration Certificate issued by concerned Regional Provident Fund Commissioner.
 - v. Copy of ESI Registration Certificate issued by concerned ESIC.
 - vi. Copies Insurance Policy(ies) as mentioned at Annexure-iv
 - vii. Copy of Labour Identification Number (i.e. LIN) Registration done in Shram Suvidha Portal of Govt. of India.
 - viii. Copy of registration under the Building and Other Construction Workers (RE&CS) Act, 1996 in case he employs ten or more building workers in any building or other construction work.
 - b) **At the time of submission of monthly bills**
 - i. **Copy of Employee Register in FORM A** under The Ease of Compliance to Maintain Registers under various Labour Laws Rules, 2017 (to be replaced by FORM IV (of Code on Wages-2019, after it comes into force).
 - ii. **Copy of Wage Register in FORM B** under The Ease of Compliance to Maintain Registers under various Labour Laws Rules, 2017 (to be replaced by Register of

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Wages, Overtime, Fine, Deduction for damage and Loss in FORM I of Code on Wages-2019, after it comes into force) duly certified by **authorized representative** of the Contractor and **authorised person** in BGL certifying as Certified that the amount shown in the column No. -

--- has been paid to the workman concerned in my presence on----- (date) at -----

(place) along with copy of bank statement duly certified by bank and copy of online transaction statement against each resource with details of name, account number, amount paid & date of payment as proof of Cashless Transaction / Payment of wages through e-banking/digital mode.


- iii. As a part of compliance and proof of depositing Provident Fund, EDLI and ESI contributions the Contractor shall submit copies of the Separate eChallans / ECR, bank receipts/bank statement in respect of resources deployed in BGL in the previous month in this contract. The documents should also contain details of resources, PF account No., ESI No., contributions of resources and employer etc.
- iv. Dully filled in statement as per Annexure- i.
- v. Copy of Wage Slips in FORM XIX
- vi. Proof of deposit of Cess under The Building and Other Construction workers Welfare Cess Act, 1996, (if applicable)

c) At the time of closure of contract

- i. Indemnity Bond of Rs. 100/- duly notarized from Notary indemnifying BGL from all liabilities w.r.t. the resource engaged by the Contractor regarding payment of wages, Provident Fund/ESI contributions, Insurance and other statutory payments. Format for Indemnity Bond is enclosed at Annexure- ii.
- ii. Copy of the Wage Register in FORM B (to be replaced by FORM-I of Code on Wages- 2019 after it comes into force) for the last month.
- iii. Copies of Service Certificates issue to resource in FORM VIII
- iv. Copy of the ECR related to EPF and ESIC Compliance in respect of Resource.
- v. Details as required for issuance of FORM - VII (Notice of Completion of Work)
- vi. Copies of FORM-C & FORM D under the Payment of Bonus Act 1965 as proof of payment towards Bonus.
- vii. Copy of proof towards release of Leave Encashment
- viii. Copies of No Dues Certificate from contract workers stating they have received all statutory payments and social benefits.
- ix. Proof towards PF KYC compliance of contract workers
- x. Proof of deposit of total Cess under The Building and Other Construction workers Welfare Cess Act, 1996, (if applicable) with final assessment from respective Cess Collector(s).

4. Verifications of bills and documents submitted by the Contractor

Before certifying/verifying the running/ final bill/invoice of the Contractor, the designated EIC of the respective contract of BGL, shall verify from the ECRs of PF/ESI, through respective web portals, the detail/status of the payment made by the Contractor. In case the information furnished by the Contractor is found to be incorrect, BGL shall take appropriate action against the Contractor under relevant conditions as available in the tender document.


 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------

Annexure-i

- 20 Statement in support of RA Bill for the Month of _____, 20_____
- (1) Name of the Firm/Agency/Contractor _____
- (2) Nature of Contract: Job/ Service _____
- (3) Period of Contract: From _____ to _____
- (a) Extension Period of Contract, if any from _____ to _____
- (b) Place where contract workmen are working _____
- (4) Postal address of the Contractor: _____
- (5) Phone No. of the Contractor: _____
- (6) Fax No. and Email of the Contractor: _____
- (7) Name and Address of PF office from where EPF Code No. has been allotted: _____
- (8) EPF Code No. allotted by PF office: _____
- (9) Name and Address of ESIC office from where ESI Code No. has been allotted: _____
- (10) ESI Code No. allotted by ESIC office: _____
- (11) Labour License No. dated _____
- (12) Validity period of Labour License from _____ to _____
- (13) Detail of Resource engaged by the Contractor:

Category	No. of Resources		Prevailing Minimum Wages
	Male	Female	
Unskilled			
Semi-skilled			
Skilled			
Highly skilled			
Total			

- (14) Copy of Wage Register in FORM B (to be replaced by FORM-I as per Code on Wages-2019, after it comes into force)
- (15) Details of deposit of contribution towards EPF:
a) EPF Challan No. _____ Amount _____ Date _____
- (16) Details of Deposition of contribution towards ESI
a) ESI Challan No. _____ Amount _____ Date _____
- (17) Whether any arrangement / agreement has been entered with any resource for extending benefits under Inter-state Migrant Workmen (RE&CS) Act, 1979: _____(Yes / No)

 <p>Bhagyanagar Gas Limited</p>	<p>RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR DEVELOPMENT OF DIFFERENT TYPE OF CNG STATIONS IN BGL AUTHORIZED GA'S Bid Document No. BGL/636/2024-25</p>	<p>VOLUME II OF II</p>
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If Yes, No. of such Inter-state Migrant Workers: _____

SIGNATURE OF CONTRACTOR/AUTHORIZED REPRESENTATIVE

Place:
Date:

Annexure - iv

Summary of Insurance Policies

Contractor is required to cover all resources deployed by him with the following insurances / schemes:

Sl. No.	SCHEME	APPLICABILITY	PREMIUM/ CONTRIBUTION	SUM ASSURED/ BENEFITS	REMARKS
1	The Employees' State Insurance Act, 1948	Applicable to all resources of the Contractor (within ESI wage limit) working in notified area.	3.25% of wages by employer 0.75% of wages by employees	Benefits under the Employees' State Insurance Act, 1948.	
2	The Employees' Compensation Act, 1923 (in lieu – of ESI mentioned at Sl. 1)	Applicable to excluded employees under ESI and those who are working in non-notified area to extend similar benefits as available under ESI Act, 1948	Premium to be calculated considering wage limit under EC Act, 1923 (i.e. Rs. 15,000/- p.m. currently)	Maximum Compensation Liability under Employee's Compensation Act, 1923 along with a Medi-claim Floater Policy with a coverage of Rs. 3 Lakhs per resource covering his/her spouse and two children	Provides compensation and medical facility to resources.
3	Group personal Accident Insurance	Applicable to all resources of the Contractor	Based on the coverage	Insured value: Rs. 5 Lakh to cover expenses associated with any accident.	Death, permanent disablement, temporary total disability or any other medical expenses related to accident.



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

4	Pradhan Matr i Suraksha Bima Yojana (PMSBY)	Eligibility – ag e group 18 to 70 years	Rs. 12/- per annum	Accidental death and permanent disability: (i) Permanent total disability–Rs. 2 lakhs. (ii) Permanent partial disability Rs. 1 Lakh.
5	Pradhan Mantri Jeevan Jyot i Bima Yojana(PMJJB)	Eligibility – ag e group 18 to 50 years. (can continue upto 55 years)	Rs. 330/- per annum.	Risk coverage – Rs. 2 Lakhs- in case of death due to any reason



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

**SECTION- 10
SCHEDULE OF RATES**



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

BHAGYANAGAR GAS LIMITED

Name of Work: RATE CONTRACT FOR COMPOSITE WORKS (MECHANICAL AND ELECTRICAL WORKS) FOR DEVELOPEMENT OF DIFFERENT TYPE OF CNG STATIONS AT BGL AUTHORISED GEOGRAPHICAL AREAS IN HYDERABAD, VIJAYAWADA AND KAKINADA

SCHEDULE OF RATES (SOR)

Sr.No.	Item Description	Quantity	Units	Estimated Rate including all taxes & duties excluding GST in Rs.	TOTAL AMOUNT (including all taxes & duties excluding GST) in Rs.
A	B	C	D	E	F
1	Mechanical & Piping Works				
1.1	SECTION-A : SS TUBE & FITTING - SUPPLY, LAYING & TESTING				
	Laying, testing and commissioning of SS tubes along with fittings as per Technical Specification, Typical P & ID for type of CNG station and scope of work, handling, lifting, transportation from stores to CNG stations.				
1.1.1	1"OD X 0.120" min Wall thk. SS Tube (Refer TS Section)	264	RM		
1.1.2	¾"OD X 0.095" min Wall thk. SS Tube (Refer TS Section)	3300	RM		
1.1.3	½"OD X 0.083" min Wall thk. SS Tube (Refer TS Section)	396	RM		
1.1.4	¼"OD X 0.035" min Wall thk. SS Tube (Refer TS Section)	264	RM		
2	SUPPLY OF SS TUBES as per Technical Specification				
2.1	1"OD X 0.120" min Wall thk.,Material SS316SS Tube (Refer TS Section)	264	RM		
2.2	¾"OD X 0.095" min Wall thk.,Material SS316SS Tube (Refer TS Section)	3300	RM		
2.3	½"OD X 0.083" min Wall thk.,Material SS316 SS Tube (Refer TS Section)	396	RM		
2.4	¼"OD X 0.035" min Wall thk. SS Tube (Refer TS Section)	264	RM		
3	Supply of SS Fittings,Valves				
3.1	Quick Connect Body & Stem				
3.1.1	QRC of 1/2" NPT , end connection:½" Tube OD, for stem & ½"NPT (F) for body Material SS316; Rated pressure : 5000 PSI @ 70°F Temperature: 0°F to 400°F	22	Nos.		
3.2	Plug				
3.2.1	Size : ½" OD, Material : SS316 (Rated pressure : 5000 PSI @ 70°F Temperature :0°F to 400°F)	44	Nos.		
3.2.2	Size : ¾" OD, Material : SS316 (Rated pressure : 5000 PSI @ 70°F Temperature :0°F to 400°F)	44	Nos.		
3.2.3	Size :1" OD, Material : SS316 (Rated pressure : 5000 PSI @ 70°F Temperature :0°F to 400°F)	44	Nos.		
3.3	Caps				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3.3.1	Size : ½" OD, Material : SS316 (Rated pressure : 5000 PSI @ 70°F Temperature :0°F to 400°F)	44	Nos.		
3.3.2	Size : ¾" OD, Material : SS316 (Rated pressure : 5000 PSI @ 70°F Temperature :0°F to 400°F)	44	Nos.		
3.3.3	Size :1" OD, Material : SS316 (Rated pressure : 5000 PSI @ 70°F Temperature :0°F to 400°F)	44	Nos.		
3.4	Union				
3.4.1	Size :1" OD, Material : SS316 (Rated pressure : 5000 PSI @ 70°F Temperature :0°F to 400°F)	66	Nos.		
3.4.2	Size : ¾" OD, Material : SS316 (Rated pressure : 5000 PSI @ 70°F Temperature :0°F to 400°F)	550	Nos.		
3.4.3	Size : ½" OD, Material : SS316 (Rated pressure : 5000 PSI @ 70°F Temperature :0°F to 400°F)	132	Nos.		
3.5	Reducing Union				
3.5.1	Tube OD 1" x Tube OD ¾", Material : SS316 (Rated pressure : 5000 PSI @70°F Temperature : 0°F to 400°F)	66	Nos.		
3.5.2	Tube OD ¾" x Tube OD ½", Material : SS316 (Rated pressure : 5000 PSI @70°F Temperature : 0°F to 400°F)	220	Nos.		
3.5.3	Tube OD 1" x Tube OD ½", Material : SS316 (Rated pressure : 5000 PSI @70°F Temperature : 0°F to 400°F)	66	Nos.		
3.5.4	Tube OD ½" x Tube OD ¼", Material : SS316 (Rated pressure : 5000 PSI @70°F Temperature : 0°F to 400°F)	20	Nos.		
3.6	Equal Tee				
3.6.1	Size:½" OD x ½" OD x ½" OD, Material:SS316 (Rated pressure : 5000 PSI @ 70°F	22	Nos.		
3.6.2	Size1" OD x 1" OD x 1" OD, Material : SS316 (Rated pressure : 5000 PSI @Temperature : 0°F to 400°F)	44	Nos.		
3.6.3	Size:¾" OD x ¾" OD x ¾" OD, Material : SS316 (Rated pressure : 5000 PSI @Temperature : 0°F to 400°F)	220	Nos.		
3.7	Reducing Union Tee				
3.7.1	1" OD x¾" OD x½" OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	66	Nos.		
3.7.2	¾" OD x ½" OD x ¾" OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	66	Nos.		
3.8	Tube End Connection				
3.8.1	¾" Tube End &1" OD with Ferrule Fitting, SS316 (Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	44	Nos.		
3.8.2	½" Tube End & ¾" OD with Ferrule Fitting, SS316 (Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	44	Nos.		
3.9	Nut				
3.9.1	1 " OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	132	Nos.		
3.9.2	¾ " OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	220	Nos.		
3.9.3	½" OD, Material : SS316(Rated pressure : 6000 PSI @ 70°F Temperature : 0°F to 400°F)	88	Nos.		



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

3.10	Front Ferrule				
3.10.1	1" OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	132	Nos.		
3.10.2	3/4" OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	220	Nos.		
3.10.3	1/2" OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	88	Nos.		
3.11	Back Ferrule				
3.11.1	3/4" OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	132	Nos.		
3.11.2	1/2" OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	220	Nos.		
3.11.3	1 " OD, Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	88	Nos.		
3.12	Male Connector				
3.12.1	Size 1/4" NPT (M) x 3/8" OD, SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	110	Nos.		
3.12.2	Size 1/2" NPT (M) x 3/8" OD, SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	110	Nos.		
3.12.3	Size 1/4" NPT (M) x 3/4" OD, SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	440	Nos.		
3.13	Cross				
3.13.1	1" OD X 1" X 1" OD X1" OD Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	22	Nos.		
3.13.2	3/4" OD X 3/4" X 3/4" OD X3/4" OD Material : SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	66	Nos.		
3.14	SS Ball Valves, conforming to Technical Specification for SS Ball Valves of following sizes, specifications as indicated below :	0			
3.14.1	2-Way Floating Normal Bore Ball Valve 3/4"	132	Nos.		
3.14.2	2-Way Floating Normal Bore Ball Valve 1/2"	132	Nos.		
3.14.3	3-Way Trunnion Mounted, Reducer Bore Ball Valve 1/2" OD end Connection and 1/4" NPT (F) bottom end connection	22	Nos.		
3.15	Conductive Core Thermoplastic Hose				
3.15.1	1/2" ID Conductive Core Thermoplastic Hose of 5.0m length for CNG Service with break away coupling along with Quick connect body & stem (End connection:1/2" Tube OD for stem & 1/2"NPT (F) for body, Material : SS316; Rated pressure : 5000 PSI @ 70°F Temperature: 0°F to 400°F) .One end of the hose shall be 1/2' OD tube and other end of the hose shall be 3/4" OD.Supply and assembling of all necessary fittings with the hose for making the end connctetions as indicated above are in the scope of contractor.	22	Nos.		
3.16	3/4" Check valve SS316(Rated pressure : 5000 PSI @ 70°F Temperature : 0°F to 400°F)	44	Nos.		
4	SECTION-B : ERECTION OF MECH. EQUIPMENT				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

4.1	Handling (including lifting and transportation from Client's store or any other CNG station within city to CNG stations) and erecting in position, the following equipment either on the foundation at Ground level or on roof minimum height at 4.0 m above ground level. Contractor's scope shall include supply of all material and accessories including but not limited to any fixtures, clamps, gasket, nut bolts, etc. :				
4.1.1	Cascade 4500/3000 L water capacity. Erection at above 4.0 M level (Refer TS Section)	5	Nos.		
4.1.2	Cascade 4500/3000 L water capacity, Erection at + Ground level upto 4.0 M (Refer TS Section)	5	Nos.		
4.1.3	Dispenser Erection on dispenser i-land	10	Nos.		
4.1.4	Compressor / DRS/ DCU , etc, any other machinery upto 6 Ton weight .Erection at Ground level / on foundation	2	Nos.		
4.1.5	Compressor / DRS/ DCU , etc, any other machinery upto 15 Ton weight .Erection at + Ground level/ on foundation	2	Nos.		
4.1.6	Compressor / DRS/ DCU , etc, any other machinery upto 20 Ton weight .Erection at + Ground level/ on foundation	2	Nos.		
4.1.7	Note: The quantities given above against individual items are indicative and shall not be considered to be binding. The quantities may increase or decrease at site at the time of actual execution and as per the discretion of Owner/ Engineer-in-charge. The unit rate shall be operated to work out the final payment due to Contractor.				
4.2	SECTION-B.1 : ERECTION OF MECH. EQUIPMENT (TRANSPORTATION NOT REQUIRED)				
	Handling (including lifting within CNG stations) and erecting in position, the following equipment either on the foundation at Ground level or on roof at 4 m above ground level. Contractor's scope shall include supply of all material and accessories including but not limited to any fixtures, clamps, gasket, nut bolts, etc. :				
4.2.1	Cascade 4500/3000 L water capacity. Erection at + 4.0 M level and above (Refer TS Section)	5	Nos.		
4.2.2	Cascade 4500/3000 L water capacity, Erection at + Ground level to upto 4.0 M(Refer TS Section)	5	Nos.		
4.2.3	Dispenser Erection on dispenser i-land	6	Nos.		
4.2.4	Compressor / DRS/ DCU , etc, any other machinery upto 6 Ton weight . Erection at Ground level / on foundation. Not applicable for dispenser	2	Nos.		
4.2.5	Compressor / DRS/ DCU , etc, any other machinery upto 15 Ton weight . Erection at + Ground level/ on foundation. Not applicable for dispenser	2	Nos.		
4.2.6	Compressor / DRS/ DCU , etc, any other machinery upto 20 Ton weight . Erection at + Ground level/ on foundation. Not applicable for dispenser	2	Nos.		
	Note: The quantities given above against individual items are indicative and shall not be considered to be binding. The quantities may increase or decrease at site at the time of actual execution and as per the discretion of Owner/ Engineer-in-charge. The unit rate shall be				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	operated to work out the final payment due to Contractor.				
5	PRESSURE GAUGES				
5.1	Supply, installation and calibration of pressure Gauges of different ranges covering from (0 to 400 bar) with suitable end connections as per EIC instructions	60	Nos.		
6	STRUCTURAL WORKS				
6.1	Pipe Supports & Other Structures	4.4	M.Ton.		
	Supply, fabrication and erection of all types of pipe supports like clamps, saddle, guide stops, cradles, turn buckles, anchors, T-posts; stockade/ trestle and pipe bridge for overhead piping; frames for canopy, approach ladders and platforms, crossover, cable tray supports, etc. including painting suitable for highly corrosive area as per specification labour and supervision & complete work as per drawings, specifications and instruction of Engineer-in-charge. (Bolts, nuts, washers, PVC coated U-clamps etc. for supporting shall be supplied by the Contractor within the rates quoted. These items will not be measured and paid separately). The work is to be completed in all respect as per scope of work and specification.				
	Notes: The quantities indicated above are tentative estimated values and hence are approximate. Final payment will be made based on actual quantities to be certified by the Owner/Owner representative. The cost of MS bolts (permanent and service(, washers, electrodes, putty, gases, cost of straightening the raw materials, cutting of flats from plates and providing splices, paints, tools, plants etc., as required for the work shall be deemed to be included in the quoted rates. All handling and transport charges of raw materials and fabricated structures including double handling, as required, for completion of work in accordance with time schedule, are deemed to be included in the quoted rates.				
7	PLAIN CEMENT CONCRETE				
	Providing, laying in position, construction and handing over of PCC in all types of concrete works including levelling courses below foundations, mass concrete works, chambers, cable trench, under floors and any other locations (which are not covered as part of respective items of SOR), at all levels and locations etc complete in all respects as per scope of work, detailed construction drawings, technical specifications and direction of Engineer-in-charge.				
7.1	a) PCC M-15 (1:2:4) [1 Cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size]	22	CU.M.		
	Note:1. Rate to include cost of all labour, tools, tackles, equipment, hire charges, supply of all materials such as minimum 43 grade cement, coarse sand and coarse aggregates, other minor construction materials, shuttering, staging, shoring/strutting,				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	finishing, etc. with all bye works and sundry works. 2. To be read in conjunction with relevent clause of PJS.				
8	Conversion of DBS to Online				
8.1	Decommissioning and Dismantalling of SS tubing from existing compressor, providing connections with online compressor,cascade as required including installation of ss tubing , fittings, valves and its testing (supply of material to be as per relevant SOR item), providing as build P&ID drawings, etc. completing all tubing/mechanical work to complete the conversion of DBS to Online station.	12	LUMPSUM		
8.2	Loading, transportation & unloading of compressor at designated location (within GA boundary: Hyderabad/ Vijayawada/ Kakinada)	12	LUMPSUM		
8.3	Loading, transportation & unloading of compressor at designated location (from Vijayawada GA to Hyderabad GA vice versa)	3	LUMPSUM		
8.4	Loading, transportation & unloading of compressor at designated location (from Kakinada GA to Hyderabad GA vice versa)	2	LUMPSUM		
8.5	Loading, transportation & unloading of compressor at designated location (from Vijayawada GA to Kakinada GA vice versa)	1	LUMPSUM		
8.6	Disconnecting all electrical connections with booster compressor/panel/other equipment, re-laying / testing of used cables if required, disconnection of earthing grid from compressor/panel/other equipment & reconection with online compressor, repair of earth electrodes etc. Any fresh supply and laying of cable/GI strip/earthing electrode to be paid as per relevant SOR.	12	LUMPSUM		
9	Architectural Works				
9.1	Supplying & Installing stickers of retro reflective vinyl (Avery / 3M / equ.) as per design pasted on dispensers. Per station	22	LUMPSUM		
9.2	Safety sign: Supplying & Installing safety sign stickers of retro reflective vinyl (Avery / 3M / equ.) as per design based on the EIC instructions 200 mm X 200 mm per station	22	LUMPSUM		
10	Supply of MS base frames support for switch gear and bracket for misc. electrical equipment, cable trays support out of roled MS section, pipes, plates etc including welding, bolting, reveting, supply of necessary anchor bolts and grouting etc supply of paints applying one coat of anti rust primer two finish coats of approved synthetic enamel paints including bracking walls, floor set for structure as required including supply of all GI hardware materials including all labour and materials complete as required and the direction of Engineer-in-charge.	22	LUMPSUM		
11	ELECTRICAL WORKS (SUPPLY, ERECTION, INSTALLATION, TESTING AND COMMISSIONING)				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

11.1	<p>Design, engineering, manufacture, shop testing, supply including packing and forwarding, transportation, delivery at storage and from storage to site including the erection, installation, testing, and commissioning of power distribution boards (PDB) as mentioned below &</p> <p>Erection, Fixing and Commissioning of MS base frame support for switch gear and bracket for misc. electrical equipment, cable tray support out of roled MS section, pipes, plates, lugs, cable ties etc including welding, bolting, reventing, necessary anchor bolts and grouting etc paints applying one coat of anti rust primer two finish coats of approved synthetic enamel paints including bracking walls, floors etc for structure as required including all GI hardware materials including all labour and materials complete as required and the direction of Engineer-in-charge.</p>				
11.1.1	<p>415 V, 30 KA single front Floor mounted/ wall mounted type indoor PDB to receive input power at CNG Station consisting of bus bar chamber, cable alley, complete with wiring, indication lamp, ammeter, voltmeter, MFM (Multi Function Meter) etc including all labour and materials with operating mechanism, all accessories, mandatory spares as per data sheet, auxiliaries etc complete in all respects as specified in technical specification, data sheet & SLD no. & as per standard Specification No. :</p> <p>Single Incomer 125 Amp 4P MCCB (with Micro processor and based O/C,S/C & E/F RELEASE with LSIG & Shunt trip) with Electrical interlock(Auto/Mannual) by Power Contactors ,Start/Stop push button with adjustable NO/NC. Outgoing with 2 nos. 100 Amp TPN MCCB (with TM based O/C,S/C & E/F RELEASE with U/V Protection for Booster feeder only)</p> <p>Outgoing with - 2 nos. 63 Amp TPN MCCB (with TM based O/C,S/C & E/F RELEASE</p> <p>Outgoing with HRC Fuses -2 nos. 32 Amp TPN MCB</p> <p>Outgoing with fuse 6 Nos. DP MCB 10 Amp with Timer(24Hrs) Auto/Mannual and with fuse 4 Nos. DP MCB 10 Amp without timer.</p>	6	Nos.		
11.1.2	<p>415 V, 30 KA single front Floor mounted/ wall mounted type indoor PDB to receive input power at CNG Station consisting of bus bar chamber, cable alley, complete with wiring, indication lamp, ammeter, voltmeter, MFM (Multi Function Meter) etc including all labour and materials with operating mechanism, all accessories, mandatory spares as per data sheet, auxiliaries etc complete in all respects as specified in technical specification, data sheet & SLD no. & as per standard Specification No. :</p> <p>Single Incomer 100 Amp 4P MCCB (with Micro processor and based O/C,S/C & E/F RELEASE with LSIG & Shunt trip) with Electrical interlock(Auto/Mannual) by Power Contactors ,Start/Stop push button with adjustable NO/NC. Outgoing with 2 nos. 63 Amp TPN MCCB (with TM</p>	3	Nos.		



Bhagyanagar Gas Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	based O/C,S/C & E/F RELEASE with U/V Protection for Booster feeder only) Outgoing with HRC Fuses 2 nos 32 Amp TPN MCB Outgoing with fuse 6 Nos. DP MCB 10 Amp with Timer(24Hrs) Auto/Mannual and with fuse 4 Nos. DP MCB 10 Amp without timer.				
11.1.3	415 V, 36 KA single front Floor mounted type indoor PDB to receive input power at CNG Station consisting of bus bar chamber, cable alley,complete with wiring, indication lamp, ammeter, voltmeter, MFM (Multi Function Meter) etc including all labour and materials with operating mechanism, all accessories, mandatory spares as per data sheet, auxiliaries etc complete in all respects as specified in technical specification, data sheet & SLD . Single Incomer of 400 Amp 4P MCCB (with Micro processor and based O/C,S/C & E/F RELEASE with LSIG & Shunt trip) with Electrical interlock(Auto/Mannual) by Power Contactors ,Start/Stop push button with adjustable NO/NC. Outgoing with - 2 nos. 400 Amp TPN MCCB (with TM based O/C,S/C & E/F RELEASE) Outgoing with 02 nos. 63 Amp TPN MCCB (with TM based O/C,S/C & E/F RELEASE) Outgoing with HRC Fuses -2 nos. 32 Amp TPN MCB, 2 Nos 32 Amp TPN MCB Outgoing with fuse 3 Nos. DP MCB 10 Amp with Timer(24Hrs) Auto/Mannual and with fuse 4 Nos. DP MCB 10 Amp without timer.	3	Nos.		
11.1.4	415 V, 36 KA single front Floor mounted type indoor PDB to receive input power at CNG Station consisting of bus bar chamber, cable alley,complete with wiring, indication lamp, ammeter, voltmeter, MFM (Multi Function Meter) etc including all labour and materials with operating mechanism, all accessories, mandatory spares as per data sheet, auxiliaries etc complete in all respects as specified in technical specification, data sheet & SLD & as per standard Specification . Single Incomer of 315 Amp 4P MCCB (with Micro processor and based O/C,S/C & E/F RELEASE with LSIG & Shunt trip) a with Electrical interlock(Auto/Mannual) by Power Contactors ,Start/Stop push button with adjustable NO/NC.Outgoing with 2 nos. 250 Amp TPN MCCB (with TM based O/C,S/C & E/F RELEASE)Outgoing with 02 nos. 63 Amp TPN MCCB (with TM based O/C,S/C & E/F RELEASE)Outgoing with HRC Fuses -2 nos. 32 Amp TPN MCB, 2 Nos 32 Amp TPN MCBOutgoing with HRC fuse 3 Nos. DP	12	Nos.		



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	MCB 10 Amp with Timer(24Hrs) Auto/Manual and with fuse 4 Nos. DP MCB 10 Amp without timer.				
11.1.5	Floor mounted APFC panel of 40KVAR capacitor bank in steps of 4X2.5, 4X5 , 10 & 20 capacitor of MIN 10 nos, consisting of bus bar chamber, cable alley, incoming(FSU),all outgoing feeder(FSUs) as specified in tender drg. no. and as per specification	2	Nos.		
11.1.6	Floor mounted APFC panel of 50KVAR capacitor bank in steps of 4X2.5, 4X5 , 10 & 20 capacitor of MIN 10 nos, consisting of bus bar chamber, cable alley, incoming(FSU),all outgoing feeder(FSUs) as specified in tender	3	Nos.		
11.1.7	Floor mounted APFC panel of 10KVAR capacitor bank in steps of 4X2.5 capacitor of 4 nos, consisting of bus bar chamber, cable alley, incoming(FSU),all outgoing feeder(FSUs) as specified in tender. and as per specification .	3	Nos.		
11.1.8	Outdoor type dust & weather proof sheet steel (2 mm thick) enclosed MCCB of following rating for mounting on wall or pedestal. 125A, 415V, 3 Pole & Neutral AC-23 duty and suitable for termination of 3.5 x 95/50 sq.mm A2XFY cable on incomer terminals and outgoing terminals.	2	Nos.		
11.1.9	Outdoor type dust & weather proof sheet steel (2 mm thick) enclosed MCCB of following rating for mounting on wall or pedestal. 250A, 415V, 3 Pole & Neutral AC-23 duty and suitable for termination of 3.5 x 120/95 sq.mm A2XFY cable on incomer terminals and outgoing terminals	2	Nos.		
11.1.10	Outdoor type dust & weather proof sheet steel (2 mm thick) enclosed MCCB of following rating for mounting on wall or pedestal. 315A, 415V, 3 Pole & Neutral AC- 23 duty and suitable for termination of 3.5 x 120/95 sq.mm A2XFY cable on incomer terminals and outgoing terminals.	2	Nos.		
11.1.11	Outdoor type dust & weather proof sheet steel (2 mm thick) enclosed MCCB of following rating for mounting on wall or pedestal. 400A, 415V, 3 Pole & Neutral AC-23 duty and suitable for termination of 3.5 x 240/150 sq.mm A2XFY cable on incomer terminals and outgoing terminals.	2	Nos.		
11.1.12	Outdoor type dust & weather proof sheet steel (2 mm thick) enclosed MCCB of following rating for mounting on wall or pedestal. 100A, 415V, 3 Pole & Neutral AC-23 duty and suitable for termination of 3.5	2	Nos.		



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	x 95/50 sq.mm A2XFY cable on incomer terminals and outgoing terminals.				
12	Design, engineering, supply, installation including packing and forwarding, transportation, delivery at storage, of the complete earthing and lightning protection system, earth electrodes/ pit, earthing including the erection, testing, commissioning, providing the test report.				
12.1	Earth Pits- GI PIPE Electrode with 6 mm thick chequered plate cover	3	Nos.		
12.2	Earth Pits- Copper plate Electrode with 6 mm thick chequered plate cover	3	Nos.		
12.3	GI Strip (50X6) mm	100	Mtrs		
12.4	GI Strip (25X3) mm	100	Mtrs		
12.5	GI lightning rod 25 mm dia. 1800 mm long including supply of all hardware bare copper rope labour etc. complete as per approved drawings, specifications and directions of Engineer-In-Charge.	2	Nos.		
12.6	Advance maintenance free earthing system with 3mtr earth electrode of low carbon steel with 250 micron copper coating with carbon based backfill compound as per IS 3043/IEEE	5	Nos.		
12.7	25 sq mm green flexible copper wire (Approx 10mtrs) along with two nos Clamps hardware etc shall be complete including mettalic cover box (suitable for outdoor), size 400X400X200 in all respect to earthing/ground of LCV at two points	6	Set		
13	Design, engineering, supply including packing and forwarding, transportation, delivery at storage, laying, termination, glanding, testing, and commissioning (conforming to IS:7098 and specification) of following sizes in trenches / excavated under ground trench/ trays, pulling through pipes and its proper sealing, cutting of paved area, roads etc. of the 1.1kV grade XLPE insulated, PVC sheathed, FRLS power and control cables (note : all are Copper conductor cables)				
13.1	3.5x 150 mm ² A2XFY	150	Mtrs.		
13.2	3.5x 120 mm ² A2XFY	150	Mtrs.		
13.3	3.5x 90 mm ² A2XFY	700	Mtrs.		
13.4	3.5x 50 mm ² A2XFY	360	Mtrs.		
13.5	4x 25 mm ² A2XFY	360	Mtrs.		
13.6	4x10 mm ² 2XWY	360	Mtrs.		
13.7	4x 6 mm ² 2XWY	1320	Mtrs.		
13.8	4x 2.5 mm ² 2XWY	2640	Mtrs.		
13.9	4x 1.5 mm ² 2XWY	2640	Mtrs.		
13.10	2x 1.5 mm ² 2XWY	1320	Mtrs.		
13.11	Supply, installation, glanding, termination, testing, commissioning of 3C X 185sq.mm and above upto 300sqmm 11kV(E) grade XLPE insulated, PVC sheathed ST2, Semi conductor screen, aluminium conductor, armoured Cables (conforming to IS:7098 and specification).	200	Mtr.		



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

13.12	Supply, installation, glanding, termination, testing, commissioning of Indoor Cable end termination kits suitable for 11 kV, 3C x 240 sq.mm XLPE cable (Heat shrinkable type).	6	Set		
13.13	Supply, installation, glanding, termination, testing, commissioning of Outdoor Cable end termination kits suitable for 11 kV, 3C x 240 sq.mm XLPE cable (Heat shrinkable type).	2	Set		
14	Supply including packing and forwarding, transportation, delivery at storage, Erection, Testing and Commissioning of lighting fixtures, Pole complete with mounting bracket, flame proof/non flame proof, control gear box as per the type of fixture, lamps etc. including civil work with pipe inserts for cables and connecting work, with all material and labour as per specifications, drawings and instruction of Engineer-in-charge. Work to be completed in all respects.				
14.1	Street lighting, integral flame proof well glass fixture (CMIFR approved for Zone-1/2 gas group IIA & IIB) with 100 W LED luminaire with flame proof control gear Model	10	Nos.		
14.2	Supply of Integral flame proof Flood Light fixture (CMIFR approved for Zone-1/2 gas group IIA & IIB) with 100 LED luminaire Baliga make or equivalent)	10	Nos.		
14.3	Supply of the underlights for the canopy as specified including lighting fixture flame proof enclosure for Bulk Head Fitting(BH/OA/124, 1 x LED, 150W)of Sudhir make or equivalent)	15	Nos.		
14.4	Street lighting pole 6mtr high GI octagonal pole (Type BOP-6030 of Bajaj make or equivalent) complete with bracket, GI clamps for fixing flame proof control gear box	15	Nos.		
14.5	Industrial Flame proof fluorescent lamp/LED fitting with lamp (type EXTL 240 of CG make or equivalent).	15	Nos.		
14.6	Flame Proof (CMIFR approved) 12" Exhaust Fan.0.25HP motor,1440 rpm. (Preferred Make: Baliga, FCG, CGL, Prompt)	2	Nos.		
14.7	Socket outlet (5/15 Amp combination) of ANCHOR ROMA make or equivalent	5	Nos.		
14.8	Wall mounted fan with electronic regulator (Energy efficient, 50W,) etc complete in all respect for wall mounting	5	Nos.		
14.9	Ceiling fan with electronic regulator (Energy efficient) etc complete in all respect for installation	5	Nos.		
14.10	Supply, Installation, testing & commissioning of 20 Mtr tall Steel tubular pole High mast towers with lighting fixtures complete with platform, 12 No's of 1X120Watts of LED light fittings (non- flameproof type), Feeder pillar etc. including junction boxes, earthing, lightning protection, aviation lamps, civil foundation etc.	6	Nos.		
15	Supply, erection of following sizes of HDPE Pipe including the bend route in required length, supply of clamps, small iron structures, spacers plugs, sealent etc. and materials complete as per approved				



**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

	drawings including the 2 Coats of Primer Painted & Fabricated support structure.				
15.1	50 mm NB	1540	Mtrs		
15.2	100 mm NB	1540	Mtrs		
16	Supply , erection , testing and commissioning of following Hot Dip Galvanized Ladder/Perforated Type cable trays (as per IS 2629) including bends, tee, crosses, horizontal and vertical splices along with Perforated type, made from 50mm height and 2.5 mm thick sheet steel & galvanized (86 microns) of following sizes including 2 Coats of Primer Painted & Fabricated support structure.				
16.1	150mm wide	330	Mtrs		
16.2	300mm wide	330	Mtrs		
17	Supply, erection and commissioning of the following including the supply of necessary clamp, bolts, rawl plugs etc. breaking and making good of walls, if required , and including all labour and materials complete as per directions of Engineer-In-Charge, applicable standards and Indian Electricity rules				
17.1	Shock hazard charts complete with frame and glass	22	Nos.		
17.2	First Aid Boxes	22	Nos.		
17.3	Caution boards (Danger, High Volatage) including supply of necessary clamps, Bolts and other hardware.	22	Nos.		
17.4	Single Line Diagram complete in glass frame.(Size 600X800mm)	22	Nos.		
18	Supply, laying and pasting of Insulating Mats 11kV grade (as per IS:15652 - 2006) of 1000mm width, required for maintenance of electrical equipment in substation as required including cutting to required shape in running length and including all labour and materials etc. complete and as per directions of Engineer-In-Charge as per applicable Indian or International standards and Indian Electricity Rules.	660	Sq.mtr		
19	Supply of aluminum (AL) ladders intended for the maintenance of industrial light poles. The ladder must be made of high-grade aluminum alloy, Anodized or powder-coated finish . Typical height adjustment may range from 6 meters to 12 meters and have a width that typically around 0.5 meters. must support a minimum load capacity of 150 kg .The ladder must be an extension or telescopic type, allowing for adjustable heights. steps must be non-slip and spaced at ergonomic intervals (approximately 300 mm apart) with minimum warranty period of 1 year .	3	Nos.		
20	All works relating to statutory approvals of the load enhancement , inspection and installation from competent authority like Electrical Inspectorate, CEIG, CEA, SEB etc. including carrying out of all required modifications in design / Manufacturer / Installation to meet the requirement of Indian Electricity rules and other statutory regulations in force, carrying out necessary paper work and liasion	1	Lumpsum		



Bhagyanagar Gas Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

with the authorities to obtain all necessary clearances for charging of installation as per relevant national standards for Mother CNG station, shamirpet. However the official fees towards the approvals shall be reimbursed by the client at actuals.				
Total in Figures				₹ -
GST @18%				₹ -
Total amount Including GST and other applicable taxes				₹ -

mtr. : Meter; Nos. : Numbers ; M. Ton : Metric Ton ; RM : Running Meters ; Sq. meter : Square Meter ; m3 = Cubic Meter, Km = Kilo meter ; M : Meter



Bhagyanagar Gas
Limited

**RATE CONTRACT FOR COMPOSITE WORKS
(MECHANICAL & ELECTRICAL) FOR DEVELOPMENT
OF DIFFERENT TYPE OF CNG STATIONS IN BGL
AUTHORIZED GA'S
Bid Document No. BGL/636/2024-25**

VOLUME II OF
II

SECTION – 11

DRAWING