Corrosion Inhibitor: Selection, Testing, Application & Performance Evaluation

Amendment Details

<table>
<thead>
<tr>
<th>Rev. No.</th>
<th>Date</th>
<th>Purpose</th>
<th>Prepared by</th>
<th>Reviewed by</th>
<th>Approved by</th>
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<tbody>
<tr>
<td>0</td>
<td>13.03.2019</td>
<td>Draft for Comments</td>
<td>CIMG</td>
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Rev. No. | Report No. | Issue Date |
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00        | CIMG-GD-5-2017-0001 |            |
1.0 Preamble

1.1 Corrosion is one of the principal threats to the integrity of pipelines. A number of measures are incorporated in the Corrosion Management System in GAIL (Ref: CIMG-FW-5-2017-0001) to manage the different corrosion threats. For combating internal corrosion arising mainly from CO₂ and H₂S in fluid streams of unacceptable levels despite either having in place other measures or any constraints therein, application of Corrosion Inhibitors (CI) is the next level of defence for the pipelines.

1.2 Use of Corrosion Inhibitors in oil/gas production and processing is well documented, although the same in transmission and distribution gas or LPG pipelines is limited.

1.3 Inhibitors are chemicals that react with a metallic surface, or the environment this surface is exposed to, giving the surface certain level of protection. Inhibitors often work by adsorbing themselves on the metallic surface, protecting it by forming a film. Inhibitors act on the corrosion processes by:
   - Increasing the anodic or cathodic polarization behaviour.
   - Reducing the movement or diffusion of ions to the metallic surface.
   - Increasing the electrical resistance of the metallic surface.

1.4 Though CI can be classified on the basis of chemical function, it is most commonly grouped according to inhibition function as below:

   a) Passivating (Anodic): This type of inhibitors cause a large anodic shift of the corrosion potential, forcing the metallic surface into the passivation range. There are two types of passivating inhibitors; oxidising anions, such as chromate, nitrite and nitrate, that can passivate steel in the absence of oxygen and the non-oxidising ions, such as phosphate, tungstate and molybdate, that require the presence of oxygen to passivate steel.

   b) Cathodic: Cathodic Inhibitors either slow the cathodic reaction itself or selectively precipitate on cathodic areas to increase the surface impedance and limit the diffusion of reducible species to these areas. Cathodic inhibitors can provide inhibition by three different mechanisms; (1) as cathodic poisons, (2) as cathodic precipitates and (3) as oxygen scavengers.

   c) Organic: Both anodic and cathodic effects are observed in the presence of organic inhibitors, but as a general rule, organic inhibitors affect the entire surface of the corroding metal when present in sufficient concentration.

   Organic inhibitors usually known as ‘film forming’ protect the metal by forming a hydrophobic film on the metal surface.
1.5 Most of the inhibitors currently employed in oil and gas systems in control of corrosion associated with CO₂ and H₂S, are organic nitrogenous compounds. Most inhibitors in successful use today are either based on the long-chain aliphatic diamine or on long carbon chain imidazolines. They can be broadly classified as below:

- Amides / Imidazolines
- Salts of nitrogenous molecules with carboxylic acids
- Nitrogen quaternaries
- Poly-oxy-alkylated amines, amides and imidazolines
- Nitrogen heterocyclic and compounds containing P, S, O

1.6 The inhibition by the above organic inhibitors, is achieved by the action of the one polar end of the molecule attaching to the metal surface and the other end; hydrophobic top tail providing the barrier to both the outward diffusion of ferrous ions and inward diffusion of corrosive species.

2.0 Objectives

2.1 This document aims to provide guidance on application of Corrosion Inhibition by introduction of chemicals in to pipelines, where required as a result of detailed study based on analysis of data covered under Guidance Document Ref: CIMG-GD-5-2016-0006 ‘Internal Corrosion Monitoring of Pipelines’. This guidance document will cover evaluation of chemicals, methods of application and monitoring effectiveness of inhibition.

3.0 Scope

3.1 The scope of this Guidance Document covers the evaluation and application of Organic type Corrosion Inhibitors against wet internal corrosion in NG and LPG pipelines due to presence of CO₂ and / or H₂S. Other forms of corrosion control such as the use of oxygen or hydrogen scavengers, biocides etc., are not covered in this document and specific studies will be required on a case to case basis wherever their uses are indicated.

3.2 The expected corrosion severity of the pipeline (‘uninhibited’ corrosion rates) and the corrosion allowance determine the requirements of design and implementation of the
inhibition system. This document shall be applicable only after a detailed assessment of corrosion has been done on the basis of data from regular monitoring of internal corrosion in accordance with Guidance Document Ref: CIMG-GD-5-2016-0006 ‘Internal Corrosion Monitoring of Pipelines’ and the requirement of application of Corrosion Inhibitors has been already established.

4.0 Approach & Methodology

4.1 Approach

4.1.1 It is the intent of Corrosion Management System of Pipelines in GAIL to limit the general internal corrosion rate to less than 1 mpy. The general corrosion rate between 1 mpy and 5 mpy calls for investigation of the causative factors for the increased rate. Increased rate beyond 5 mpy calls for further detailed investigation and mitigation measures such as increased control of gas / LPG quality and/or corrosion inhibition by chemical injection.

4.1.2 In most cases of GAIL pipeline systems transporting NG, suppliers deliver NG to GAIL after treatment for removal of moisture, CO₂ and H₂S and internal corrosion is not likely. In few of the regional pipelines lacking similar upstream treatment and in case of LPG pipelines where LPG quality specifications still need improvement, it may become necessary to consider CI application when high internal corrosion rates are observed.

4.1.3 In case of NG being delivered to GAIL without treatment, the suppliers have been mandated to inject CI before delivery of gas to GAIL for transportation. However in certain cases, due to the length of pipeline and other factors, it may require to be supplemented at GAIL stations to restrict the internal corrosion rate within the stipulated level. In case of LPG, the product is presently delivered without any CI and requirement of the same may be indicated in certain cases even as the quality of LPG delivered may still meet the present quality specifications (IS:4576).

4.1.4 Given the nature of supply and service and the critical importance of corrosion control in such cases where higher corrosion rates are already indicated calling for CI application, the agency and the candidate Corrosion Inhibitor(s) together with application facilities shall be selected by competitive bidding under two stages viz., techno-commercial qualification and price.

4.1.5 Once requirement of applying Corrosion Inhibitors is established in a pipeline or group of pipelines where CIs haven’t been applied before and facilities for CI application is not built into the system, bids shall be invited on Open NIT with intimation to known CI suppliers/service companies (if any).
4.1.6 In case of pipeline systems where CI was applied earlier or is being continued to be applied, the focus will then on the procurement of chemicals and continuation of application services.

4.1.7 In either case i.e., first time or repeat / continued application, the approach shall be hiring competent agencies to install CI application facilities and connections in existing pipelines and/or providing services of supply & application of chemicals. Although, the scope of supply of chemicals is included in the scope of the CI service provider, monitoring its effectiveness shall be done separately.

4.1.8 The application of CI is done either by continuous injection or by sending a batch of CI between a pair of pigs or a combination based on the severity to be addressed. However, initially the approach will be to apply Corrosion Inhibitors on continuous basis at a rate established from lab tests and further fine-tuned during field trials. In case it is established that CI application on continuous basis alone is not sufficient to contain the corrosion rate to within target levels and if batch application is required, the same may be arranged with the contractor separately or through a separate contract.

4.2 Methodology

4.2.1 Selection of Chemicals and Chemical Supply & Service Agency

4.2.1.1 The selection of candidate Corrosion Inhibitors is done for a specific Application Window (pipeline operating conditions) and for a defined Integrity Operating Window (IOW).

4.2.1.2 The Applications window specifies the physical parameters such as the composition of Natural Gas or LPG, water content & chemistry, other chemicals if injected (viz., odorants, biocides etc.) and operating conditions such as P, V, T, Flow etc.

4.2.1.3 The IOW covers the full range of operating conditions that impact the corrosion rate and corrosion inhibitor effectiveness. A CI qualified for an IOW implies that if conditions exceed the defined window the CI performance cannot be assured and re-evaluation is required.

4.2.1.4 For a specific pipeline section or sections in a network, tenders shall be invited by the concerned RIMG, on open tender basis to select the chemical service provider along with the candidate Corrosion Inhibitor(s) and application infrastructure (if not installed already) for the given application. A Model Scope of Works (SOW), Special Conditions of Contract (SCC) and Schedule of Rates (SOR) are given in Appendix-1. The bids received shall be evaluated in accordance with the parameters given in above model.
tender and the potential agencies along with particular chemical or cocktail of chemicals, shortlisted for the purpose of application for the first time or repeat / continued application of CI.

4.2.1.5 The process of selection of chemical and chemical service company shall be done by both lab and field tests. The key features of the above evaluation contained in the model tender document are given below:

a) The CI shall be a chemical or combination of chemicals based on Organic Corrosion Inhibitors.

b) A screening protocol based on lab tests defined at Appendix-1 (Model Scope of Works (SOW), Special Conditions of Contract (SCC) and Schedule of Rates (SOR)) shall be applied at the Techno-commercial qualification stage of tender, for selection of candidate CIs and agencies

c) Post award, there shall be rigorous field test for initial 6 months and routine monitoring thereafter for effectiveness of CI in the given application. At any point during the initial field trial period or subsequent service period, in case, the candidate CI and / or services of Agency is found deficient against the KPIs set for the field trial (given at 4.2.2), the contract shall be terminated at that stage. Payment for the CI and Services shall be made only to the extent of 50% of contract rate in such case.

4.2.2 Monitoring Effectiveness of CI

4.2.2.1 The selected CI shall be applied in the pipeline section required and performance monitored with respect to KPIs as given below at the frequencies indicated during the initial 6 months trial period and the subsequent service period.

<table>
<thead>
<tr>
<th>S No</th>
<th>KPI</th>
<th>Using</th>
<th>Frequency during 6 months trial</th>
<th>Frequency during subsequent service</th>
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<tr>
<td>1</td>
<td>Inhibited Corrosion Rate (mpy):&lt; 1 mpy or 50% Reduction in Uninhibited rate if the same is between 1to 2 mpy</td>
<td>ER Probe</td>
<td>Online</td>
<td>Daily</td>
</tr>
<tr>
<td>2</td>
<td>CI Consumption:</td>
<td>Records</td>
<td>Weekly</td>
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</tr>
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<td>S No</td>
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<td>Using</td>
<td>Frequency during 6 months trial</td>
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<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------</td>
<td>---------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td><strong>CI System availability:</strong></td>
<td><strong>Records / Log Books</strong></td>
<td><strong>Weekly</strong></td>
<td><strong>Monthly</strong></td>
</tr>
<tr>
<td></td>
<td>99 % calculated on weekly basis / monthly basis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>Breach of CI Safe Inventory level:</strong></td>
<td><strong>Records / Log Books</strong></td>
<td><strong>Weekly</strong></td>
<td><strong>Monthly</strong></td>
</tr>
<tr>
<td></td>
<td>Zero instance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.2.2.2 As a minimum, any pipeline section where CI injection is called upon, at least three sets of Corrosion Monitoring Coupon & Probe pairs shall be installed; one set upstream of CI Injection point, one set after CI injection point (as far away as possible from the CI injection point but within the same station) and third set at the station/terminal at the farthest end of the pipeline to compare the inhibited and uninhibited corrosion rates.

4.2.2.3 Where the performance is not meeting the criteria during initial trial period, the contractor shall be asked to investigate the reasons and take corrective action on an extended trial period of further three months. Even at the end of the extended trial period, the performance criteria are not achieved; there shall be an analysis of the trial work for corrective action which may include termination of the contract and revisiting the CI type, dosage and other pertinent factors.

4.2.2.4 On successful completion of trial period, the regular service period will commence which will be typically for three years. During this period, the efficacy and need for CI injection shall be reviewed at least after once midway i.e., after 18 months of commencement of CI injection.

5.0 **Definitions**

a) Continuous inhibitor: an inhibitor that is continuously injected into the system in order to effect inhibition. Since the surface receives full exposure to the inhibitor, the film repair is continuous.

b) Emulsification tendency: A property of an inhibitor that causes the water and hydrocarbon mixture to form an emulsion. The emulsion formed can be quite difficult to remove and this
will lead to separation difficulties in the production facilities.

c) Minimum effective concentration: Inhibitor concentration recommended by the manufacturer for injection in pipeline. This value should satisfy the requirement of tests under clause no. 4.

d) Wall shear stress (τ, N/m²): Force per unit area on the pipe due to fluid friction.

6.0 Applicable Standards

6.1 ASTM G 170, 'Standard Guide for Evaluating and Qualifying Oil field and Refinery Corrosion Inhibitors in the Laboratory'

6.2 ASTM G 184 Standard Practice for Evaluating and Qualifying Oil Field and Refinery Corrosion Inhibitors Using Rotating Cage

6.3 NACE International publication ID 182 Wheel test method used for evaluation of film persistent corrosion inhibitors for Oil field applications.

6.4 NACE International publication 31215 "Laboratory evaluation of corrosion inhibitors used in Oil and Gas Industry".
MODEL TENDER FOR APPLICATION OF CORROSION INHIBITORS IN NG / LPG PIPELINES

SCOPE OF WORK & SPECIAL CONDITIONS

1.0 BACKGROUND

1.1 GAIL (India) Ltd is a Central Public Sector Undertaking (PSU) under the Ministry of Petroleum & Natural Gas (MoP&NG) Government of India. GAIL operates network of Natural Gas Pipelines covering more than 11000 Km with a capacity of appx 206 MMSCMD & two LPG Pipelines covering 2040 Km with a capacity of 3.8 MMTPA of LPG. Along the pipelines, there are booster/compressor stations. In addition, GAIL owns seven process plants across India for extraction of liquid hydrocarbons from natural gas and integrated petrochemical complex producing 900 KTA of polymers.

2.0 OBJECTIVE

2.1 GAIL intends to hire the services of a reputed companies experienced in chemical treatment in control of internal corrosion by dozing of Corrosion Inhibitors in the following GAIL pipelines in [Concerned RIMG to specify].

a) xxxx
b) xxxx
c) xxxx

3.0 PREQUALIFICATION REQUIREMENTS

3.1 Financial

The agency to be engaged through this tender shall be of sound financial standing evidenced by the following:

e) The turnover in any of the preceding three financial years shall be minimum Rs $xx Crores (US$ xxx, xxx)
f) The net worth of the agency shall be positive in the immediate preceding financial year.

Documentary evidence in support of the same shall be provided along with the proposal.
3.2 Technical

a) The agency to be engaged by GAIL for this job shall be a bonafide manufacturer or manufacturer authorized supplier / Service Company who must have completed execution of at least one contract in installation of Corrosion Inhibitor Dozing Facility in hydrocarbon pipelines in preceding seven years prior to the application submission date.

[And / Or] * to be specified based on the scope of tender

b) The agency to be engaged by GAIL for this job shall be a bonafide manufacturer or manufacturer authorized supplier / service company who must have completed execution of at least one contract in application of Corrosion Inhibitor in LPG / Natural Gas pipelines in preceding seven years prior to the application submission date.

c) Self-attested documentary evidence in support of above is required to be attached along with Application Form.

4.0 SCOPE OF WORK

4.1 The particulars and operational details of the pipeline(s) for which Corrosion Inhibitor Injection is proposed under this contract is given at Annexure A. The NG / LPG quality data is given at Annexure B1 / B2.

The scope of work of the selected agency(ies) shall be as follows:

[Users may retain / delete sections appearing below based on whether CI injection / monitoring facilities are required or only service for CI injection is required]

4.2 Design, Supply, Installation, testing and commissioning of Injection System(s): SOR

4.2.1 Contractor shall be responsible for design, supply, installation, testing and Commissioning of Injection system(s) at designated locations of GAIL for application and monitoring of Corrosion Inhibitors. The injection system shall include all necessary equipment such as injection points (valves, quills), injection ports, connecting lines, injection pumps, storage tank, mixing tank, inhibitor rate monitoring and all required control & instrumentation.

4.2.2 The injection port & quills and monitoring equipment (ER Probes) shall be required on operational natural gas and LPG pipelines and hence the same are to be installed online by hot-tapping. The bidder shall furnish a detailed list of equipment required, their specifications and numbers per location, method of installation and make/model along
with their techno-commercial offer.

4.2.3 The Contractor shall design the system suitable for the particular site / pipeline comprising the minimum equipment given as under. Contractor shall submit the design and selected equipment data sheets & specifications to GAIL for approval, installation and commissioning. The following shall be essential elements of the design:

4.2.3.1 The entire system shall be fabricated / constructed using Corrosion Resistant material (CRA). The pressure rating of such system shall be compatible with that of the piping where CI injection is required.

4.2.3.2 CI injection point into pipeline / piping shall be installed at a location after filter / separators.

4.2.3.3 The tanks, pumps and all other components of the CI Injections system shall be skid mounted – packaged design for easy installation.

4.2.4 The CI injection system to be installed at the GAIL Location (Gas / LPG terminal) by the contractor under the scope of this contract shall comprise of the following minimum but includes other accessories / systems to make a functional unit able to deliver the CI at the required dosage on continuous basis.

   a) Stock Tank: Minimum One No. for storage of the CI mixed with carrier solvent and connected to the CI injection system for uninterrupted dosing at required levels.

   b) Suction Strainer Minimum One No. to remove the dirt / sludge prior to the entry of CI into metering pump check valve system.

   c) Pumps (I main + 1 standby) (as per specifications at Annexure-C): Metering pump, positive displacement type, motor-driven, variable stroke length with a 10:1 capacity range from maximum to minimum setting. The pumping action is developed by a reciprocating piston that is shielded from the fluid by a diaphragm. Diaphragms are actuated by hydraulic fluid between the piston and the diaphragm. The pumps to be supplied for CI injection for a given pipeline shall be selected such that the ‘Specified Injection Rate’ given by the bidder is within 40% to 60% of the span of its pumping rate.

   d) Calibration Column: Minimum one no. installed between Stock tank and the pump with isolation valve downstream to check the pump dosing rates.
e) Piping / tubing, isolation valves, three-way valves, non-return valves, relief valves to form the circuit from Stock tank - mixing tank - day tank – suction strainer -

f) Access fitting and Quill (as per specifications at Annexure-D) to be installed on the existing piping (on-line retrievable type) to be installed online by hot tapping. There shall be a minimum of two installations (1 connected + 1 spare) of Access fittings and Quill assembly at each location in order to meet the exigency of any problem. Number sets of Access fitting & Quill to be installed is indicated in the SOR.

g) Corrosion Monitoring Probes (ER Probes) and coupons (as per specifications at Annexure-E) to be installed upstream of CI Injection, downstream of CI injection and at the farthest end of pipeline to enable monitoring of CI injection effectiveness. The probes / coupons shall be flush mounted with 2” access fittings to be installed online by hot-tapping at 6 ‘O’ Clock position. The ER probes shall be installed with transmitter directly mounted on the access fitting with local display and connected to local control room. Supply & Installation of ER Probe complete with access fitting and installation by conventional /hot-tapping as per GAIL requirement, transmitter, signal cabling up to Dozing Skid and Control room shall be in the scope of contractor. Actual Number of probes to be installed is indicated in the SOR.

h) Instrumentation system pressure transmitters, switches and control systems to monitor and control the CI dozing.

i) Transfer devices for transfer of CI from transportable drums in to stock tank.

j) Vent lines from tanks / containers and relief valve outlets should be scrubbed through a bed of activated carbon in order to absorb the solvent vapours.

k) Minimum one set of retrieval tool and kit for each installation of Mass Loss Coupon & ER Probe and Access Fitting & Injection Quill assembly shall be provided.

l) Contractor shall provide all the required spares for commissioning the entire system of CI Injection and monitoring and maintaining the same in such condition required for providing a minimum 99% availability of CI injection at all times during the contract period.

4.2.5 The space for installation of equipment and power supply for the system shall be provided by GAIL inside the Despatch Terminal on the pipeline to be treated. The contractor shall be responsible for preparing the ground, any civil platform / foundation
that is required for installation of skid mounted systems and tanks.

4.2.6 The work of hot-tapping on GAIL pipeline / piping to install the CI injection access fitting & quill and access fittings & corrosion monitoring ER probes shall be in the scope of Contractor for which competent hot-tapping agencies shall be hired by the Contractor with the approval of GAIL.

4.2.7 All the equipment forming part of the CI system to be designed, supplied and installed by the Contractor shall be suitable for the ‘Hazardous Area Classification’ for the location of installation in accordance with IS-5571 “Guide for Selection Electrical Equipment for Hazardous Area”, IEC 60079-0 “General Requirements for Electrical Apparatus for Explosive Gas Atmosphere” and OISD -113 “Classification of Areas for Electrical Installations at Hydrocarbon Processing and Handling Facilities”.

4.3 Supply, storage and application of Corrosion Inhibitor : SOR Group B

4.3.1 Contractor shall be responsible for supply, storage and application of Corrosion Inhibitor on a continuous basis at the rate determined by lab and field testing. The specific Corrosion Inhibitor for application shall be selected by GAIL through a detailed protocol of lab and field testing to be done by the selected agency witnessed by GAIL representative(s) and further its effectiveness monitored in an initial field trial period followed by periodical field verification.

4.3.2 Minimum Technical Requirements of Corrosion Inhibitors is given at Annexure – F; Bidder may give his confirmation where mandatory and offer supplementary information where applicable.

4.3.3 The bidding agencies shall specify their candidate(s) of Corrosion Inhibitors specifically suitable for addressing internal corrosion in natural gas or LPG (typical quality specification given in Annexure- B1 / B2) due to CO₂ and H₂S intended for continuous injection. The bidder shall furnish detailed specification of Corrosion Inhibitors offered along with their track record of use in corrosion control in their techno-commercial offer along with the ‘Specified CI Injection rate’ in ppmw to contain the corrosion rate to within target level.

4.4 The candidate Corrosion Inhibitors offered by the bidder shall be subjected to a series of laboratory tests as part of techno-commercial qualification of the tender process. The tests shall be conducted by third party laboratories not affiliated to the bidder in any manner whatsoever. The bidder shall confirm that all costs in such lab testing shall be borne by the bidder and the bidder shall also furnish a list of third party labs for such
tests, along with their techno-commercial offer (Annexure- G). The acceptable labs for the testing shall be finalized and intimated to all the bidders by GAIL after preliminary assessment of Techno-commercial offers. The list may or may not include labs proposed by the bidder. Bidders shall confirm acceptance of the labs notified and their costs thereof, for proceeding to technical qualification and price bid opening and bids of those bidders not confirming the same within the stipulated time shall not be considered for further evaluation.

4.5 After the candidate CIs have been screened through lab testing and evaluated, the price bids of bidders whose samples are successful in the lab tests as per the given criterial of protection. The price for evaluation of offers by different bidders then shall be done in the following manner:

a) The quantity of CI required for the period of one year of uninterrupted injection for the flow rate given by GAIL and the ‘Specified Injection Rate’ given by the bidder in ppmw, shall be calculated.

b) The price quoted by the bidder per kg shall be multiplied by the quantity arrived at (a) above.

c) The price quoted by technically qualified bidders thus calculated above shall be compared to select the lowest techno-commercially qualified bidder.

4.6 Upon award of work, the selected CI shall be applied in the pipeline section required and performance monitored with respect to KPIs as given below at the frequencies indicated during the initial 6 months trial period and the subsequent service period.

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<td>2</td>
<td>CI Consumption:</td>
<td>Records</td>
<td>Weekly</td>
<td>Monthly</td>
</tr>
<tr>
<td></td>
<td>Calculated Quantity based on</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S No</td>
<td>KPI</td>
<td>Using</td>
<td>Frequency during 6 months trial</td>
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<td>----------------------------------------------------------------------</td>
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<td>----------------------------------</td>
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</tr>
<tr>
<td></td>
<td>vendor indicated dosage rate for the inhibited corrosion rate above ± 10%</td>
<td></td>
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4.7 Where the performance is not meeting the criteria given above during initial trial period, the contractor shall be asked to investigate the reasons and take corrective action on an extended trial period of further three months. Even at the end of the extended trial period, the performance criteria are not achieved; there shall be an analysis of the trial work for corrective action which may include termination of the contract and revisiting the CI type, dosage and other pertinent factors.

4.8 On successful completion of trial period, the regular service period will commence which will be typically for three years. During this period, the efficacy and need for CI injection shall be reviewed at least after once midway i.e., after 18 months of commencement of CI injection.

4.9 Contractor shall arrange at his own cost a warehouse within 100 Km of the GAIL location where CI injection is required, with all necessary statutory permissions for storage of Corrosion Inhibitors and other chemicals in adequate volumes for uninterrupted supply of CI to location but not less than 1 month requirement for the location. This storage shall be available for inspection by GAIL as and when required.

4.10 The Contractor shall be responsible for maintaining the stock tank at CI injection location filled for a minimum period of 7 days for uninterrupted application of CI. It shall be the responsibility of the agency to maintain the required stock at Warehouse and Location with all necessary transportation, loading / unloading, transfer logistics.
4.11 The contractor shall be responsible for the regular preventive and breakdown maintenance of the CI injection system including the pumps, fittings, electrical systems, instrumentation etc., such that the continuous CI injection is not interrupted. All spares and consumables used in preventive / breakdown maintenance shall be borne by the Contractor [In case the tender does not include installation of CI Injection systems and the same is already available at the GAIL Location, the list of equipment to be covered under the maintenance by CI Service Company under this contract shall be attached as Annexure H. In such case, the Contractor shall be deemed to have inspected the existing system before making their bid].

5.0 CONTRACT DURATION

5.1 The contractual Completion for Design, Supply & installation of CI system (if included in the contract) is 12 (twelve) months from the date of Fax of Intent (FOI). Time taken in design approval by GAIL (from the date of receipt of complete design, equipment data / specifications sheets up to formal communication of approval) shall be excluded from the above completion period. Time for clearance from GAIL for installation at Location, hot-tapping etc., and any delay in work permits etc., shall also be excluded from the contract on the basis of written documentation signed by both GAIL and Contractor representative.

5.2 The contract duration for supply and application of CI chemicals shall comprise of two parts:

5.2.1 Field trial period to establish technical suitability and adequacy at field shall be 6 (six) months extendable to further 3 (Three) months. A period of 1 (one) month mobilization period shall be applicable from the date of Fax of Intent (FOI) for reckoning this period.

5.2.2 The contract duration on successful completion of field trial shall be 3 (Three) years from the date of completion of field trial as per 4.1.1 above.

6.0 TERMS OF PAYMENT

6.1 Paying Authority:

Head of Department – F&A

Office

6.2 Payment for SOR Group A items shall be made as below:

6.2.1 20% on approval by GAIL of the design document and Equipment data sheets / specifications.
<table>
<thead>
<tr>
<th>Title</th>
<th>Corrosion Inhibitor: Selection, Testing, Application &amp; Performance Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Guidance Document</td>
</tr>
<tr>
<td>Reference No.</td>
<td>CIMG-GD-5-2017-0001</td>
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</tbody>
</table>

6.2.2 30% on receipt of material at site on certification of the Site-in-Charge.

6.2.3 40% on successful erection / commissioning.

6.2.4 10% after 9 months of successful operations certified by Site-in-charge.

6.3 The SOR Group B items shall be paid as below:

6.3.1 The rates quoted against the CI Injection services including supply, storage, transfer and application of chemicals during the initial trial period shall be paid on the monthly basis up to 50% of the contract rate. The balance shall be payable if and when the trial is completed successfully.

6.3.2 During the regular service period after successful field trial period, the contract rates shall be paid in full on a monthly basis subject to the condition that the dosage rate of CI and consumption of CI is within ± 5% of the calculated amount of CI for the actual flow of gas / LPG at the ‘Specified Injection Rate’ else, reduced for the extent of excess quantity beyond the calculated quantity based on the ‘Specified Injection Rate’.

6.4 Payments above shall be subject to deduction of all applicable taxes, duties and levies prevailing at the time of payment.

7.0 CONFIDENTIALITY OF INFORMATION AND DATA

7.1 All information obtained by bidder during the project and all information / data / maps etc. provided by the Company to the bidder must be considered confidential and must not be divulged by the bidder or its personnel to any-one other than the Company’s personnel. This obligation of bidder shall be in force even after the termination of the contract. No part of the consultancy work shall be permitted to be presented and/or published in scientific / technical papers / journals etc. without prior approval of the Company in this regard.

8.0 ADVANCE PAYMENT & MOBILISATION ADVANCE:

No payment in advance or by any of mobilization shall be payable under this contract.

9.0 DEFECT LIABILITY PERIOD:

One year from the date of completion of Contract in case of Group-A of SOR and three months for Group-B of SOR.

10.0 PRICE REDUCTION SCHEDULE

10.1 Design, Supply, Installation and Commissioning of CI Injection System (if part of the contract): In case, the Contractor fails to complete the work within the stipulated period...
and timelines as mentioned at 5.1 of this part of the document, then, unless such failure is due to owner’s default, the consultant shall pay to the owner, by way of compensation for delay and not as penalty, a sum at the rate of ½ % (half percent) of the specific item(s) of SOR subject to the total value of the individual SOR item for delay per week or part thereof subject to a maximum of 5% of the total value of the Group-A.

10.2 In case of 5.2 of this document applicable to Supply and Application of CI chemicals, the delay in mobilization i.e., the period beyond allowable mobilization period up to actual commencement of service shall be treated as compensation for delay at the rate of ½ % per week of delay or part thereof of the specific item(s) of SOR subject to the total of 5% of the total contract value of Group-B of SOR. In case of interruption in service, unless the same is on account of GAIL, the same shall be levied a price reduction at the rate of double the amount applicable for the prorated period calculated on the basis of monthly rate given in the contract.

11.0 CONTRACT PERFORMANCE BANK GUARANTEE:

11.1 The contract Performance Bank Guarantee shall be submitted by the Contractor within 15 days of date of Fax of Award (FOA) as below:

a) A separate Bank Guarantee for 10% value of Group-A of SOR total value (if part of the contract). The same will be in force for one year of contract performance period reckoned from the date of successful commissioning of the system duly signed by both the contractor and GAIL representative.

b) A separate Bank Guarantee for 10% of annualized value for Group-B total value valid for the entire contract duration as mentioned in 5.2 for the total of trial and regular service period plus three months.
## CHECKLIST FOR PREQUALIFICATION

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Name of the Agency</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Address (HQ)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Address (Bidding Unit)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Designated Person for Communication with Job Title</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Address of Designated Person</td>
<td></td>
</tr>
<tr>
<td></td>
<td>e-mail address</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mobile Number</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Landline Number</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fax Number</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Pre-Qualifying Technical Requirements (Attach documents)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>One work of supply and application of Corrosion Inhibitor in hydrocarbon</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pipelines in the preceding seven years prior to the application submission</td>
<td></td>
</tr>
<tr>
<td></td>
<td>date.</td>
<td></td>
</tr>
</tbody>
</table>
Self attested documentary evidence in support of above is required to be attached along with Application Form.

<table>
<thead>
<tr>
<th>7</th>
<th>Financial</th>
<th>Indicate Currency:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Turnover in last 3 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Net Worth as on 31.3.XXXX</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Attach Audited Balance Sheet – last 3 years</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8</th>
<th>Other information demonstrating bidder’s competence (attach documents)</th>
<th>Provide a list of key personnel with CVs</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>9</th>
<th>Candidate Corrosion Inhibitor offered for Natural Gas Pipelines</th>
<th>Mention brand name, type, past track record; attach detailed technical documentation</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>10</th>
<th>Candidate Corrosion Inhibitor offered for LPG Pipelines</th>
<th>Mention name, type, past track record; attach detailed technical documentation</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>11</th>
<th>Corrosion Inhibitor Injection system offered for NG Pipelines</th>
<th>Mention list of equipment, make, model, numbers and attach detailed technical documentation</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>12</th>
<th>Corrosion Inhibitor Injection system offered for LPG Pipelines</th>
<th>Mention list of equipment, make, model, numbers and attach detailed technical documentation</th>
</tr>
</thead>
</table>

Place: __________________________
Date: __________________________

________________________
(Authorised Signatory)

**Note:** Documents in a language other than English shall be accompanied by self-certified English translated copies.
### Annexure-A

**Pipeline Particulars and Operational Parameters**

[GAIL to provide one sheet of this Annexure for each of the pipeline to be covered under the Contract]

1. **Pipeline Particulars**

<table>
<thead>
<tr>
<th>Pipeline Section Code</th>
<th>Pipeline Section Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material Grade, Thickness</th>
<th>Internal Coating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Network Name</th>
<th>CI Injection Facilities</th>
<th>CI Injection Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>☐ Exists ☐ To be installed under the contract</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Corrosion Monitoring Location</th>
<th>Injection Location:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>End Location:</td>
</tr>
</tbody>
</table>

2. **Pipeline Design & Operating Conditions**

<table>
<thead>
<tr>
<th>Design Pressure, kg/cm²</th>
<th>Design Temperature, ºC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service</th>
<th>LPG</th>
<th>Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design Flow Rate (MTPD (LPG) / MMSCMD (NG))</th>
<th>Operating Pressure , kg/cm²</th>
<th>Operating Temperature, ºC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max: Normal: Min:</td>
<td>Max: Normal: Min:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Flow Rate (MTPD (LPG) / MMSCMD (NG))</th>
<th>NG / LPG Quality Data</th>
<th>Corrosion Monitoring Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ref: Annexure C1 / C2</td>
<td>Attach Coupon / Probe data for past one year minimum</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Corrosion Rate (mpy)</td>
<td>Target Corrosion Rate (mpy) after injection of Corrosion Inhibitor offered by bidder under this contract</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>

00  
CIMG-GD-5-2017-0001
### Natural Gas Quality Report (for the Specific Pipeline at Annexure-A)

<table>
<thead>
<tr>
<th>Parameter (Constituent)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corrosive Agents</strong></td>
<td></td>
</tr>
<tr>
<td>Oxygen, mol%</td>
<td>Max: Normal: Min:</td>
</tr>
<tr>
<td>Hydrogen Sulphide (H(_2)S), ppmw</td>
<td>Max: Normal: Min:</td>
</tr>
<tr>
<td>Mercaptans, ppmw</td>
<td>Max: Normal: Min:</td>
</tr>
<tr>
<td>Total Sulphur, ppmw</td>
<td>Max: Normal: Min:</td>
</tr>
<tr>
<td>Carbon dioxide (CO(_2)), mol %</td>
<td>Max: Normal: Min:</td>
</tr>
<tr>
<td>Water dew point (at flowing pressure ___ kg/cm(^2)), °C</td>
<td>Max: Normal: Min:</td>
</tr>
<tr>
<td>HC Dew Point, (at flowing pressure ___ kg/cm(^2)), °C</td>
<td>Max: Normal: Min:</td>
</tr>
<tr>
<td><strong>Physical Parameters</strong></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td></td>
</tr>
<tr>
<td>Vapour Pressure</td>
<td></td>
</tr>
<tr>
<td>Flammability</td>
<td></td>
</tr>
<tr>
<td>Viscosity</td>
<td></td>
</tr>
<tr>
<td>Solubility in Water</td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td></td>
</tr>
<tr>
<td>Odour</td>
<td></td>
</tr>
</tbody>
</table>

* Data of past minimum one year may be studied to fill the above data
### Typical LPG Quality Specifications (for the Specific Pipeline at Annexure-A)

<table>
<thead>
<tr>
<th>Parameter (Constituent)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corrosive Agents</strong></td>
<td></td>
</tr>
<tr>
<td>Hydrogen Sulphide (H₂S), ppmw</td>
<td>Max:</td>
</tr>
<tr>
<td>Total Sulphur after odorizing, ppmw</td>
<td>Max:</td>
</tr>
<tr>
<td>Moisture, ppmw</td>
<td>Max:</td>
</tr>
<tr>
<td>Caustic</td>
<td>Max:</td>
</tr>
<tr>
<td>Copper strip corrosion</td>
<td></td>
</tr>
<tr>
<td><strong>Physical Parameters</strong></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>LPG in gaseous state is 1.5 to 2.0 times heavier than air. However in liquid state its density is approximately half of water and ranges from 0.525 to 0.580 @15 °C.</td>
</tr>
<tr>
<td>Vapour Pressure</td>
<td>Vapour pressure of LPG is about 8 kg/cm² @ 38 °C.</td>
</tr>
<tr>
<td>Flammability</td>
<td>LPG has an explosive range of 1.8% to 9.5% volume of gas in air. This is considerably narrower than other common gaseous fuels. However auto ignition temperature of LPG is around 410-580 °C and it does not ignite on its own at normal temperature.</td>
</tr>
<tr>
<td>Viscosity</td>
<td>LPG has low viscosity of around 0.3 eSt @ 45 °C and can leak when other petroleum products cannot. This demands a very high integrity of pressurized system to avoid leakage. It is a poor lubricant too.</td>
</tr>
<tr>
<td>Combustion</td>
<td>The combustion reaction of LPG increases the volume of product in addition to the generation of heat. LPG requires up to 50 times its own volume of air for complete combustion. Upon combustion it yields 3 to 4 times its own volume of carbon dioxide, along with 1 0900 kcal heat per kg.</td>
</tr>
<tr>
<td>Evaporation</td>
<td>When pressure is released LPG vaporizes rapidly, lowering its surrounding temperature considerably. This may lead to frost burn when come in contact of LPG. Hence special care shall be taken to wear Skin Protection clothing such as gloves and goggles, when there is a possibility of coming in contact with LPG.</td>
</tr>
<tr>
<td>Auto-refrigeration Effect of Vaporization</td>
<td>When LPG escapes from an opening, it lowers the surrounding temperature thereby freezing the water vapour in the atmosphere and making the escaping LPG vapour appear as a whitish cloud. Even if</td>
</tr>
</tbody>
</table>
this cloud disappears, it is not a sign that the inflammmable gas/air mixture is dispersed. Leaking liquid phase LPG will rapidly expand to around 250 times its own volume, thereby creating a greater risk than would occur with a similar size vapour leakage.

**Solubility of Water**

Because of a very low solubility of LPG in water, the identification of minor leakage in water is faster and easier. Water present in LPG may cause rust I corrosion and freeze the drain valve, excess flow check valve, cylinder valve or regulator. Ice formation may prevent the complete closure of drain valve, self-closing valves, bleeders in LPG lines & vessels etc. and result in leakage of LPG. Ice crystal formed at the regulator orifice may lead to plugging of the orifice and thus stopping the flow of LPG. Ice crystal may also make the linkages in a regulator inoperable.

**Flame Propagation**

LPG liquid released forms vapour that can travel long distance. The LPG vapour can give violent concussion upon explosion due to faster flame propagation than in case of hydrogen.

**Odour**

LPG has only very faint smell and consequently it is necessary to add some odorant so that any escaping gas can be easily detected. Ethyl Mercaptan is normally used as stanching agent for the same. The amount to be added shall be sufficient to allow detection in atmosphere 1/5 of lower limit of flammability / odour level 2 as per IS: 4576.

**Colour**

LPG is colourless both in liquid and vapour phase.

* Data of past minimum one year may be studied to fill the above data
## Minimum Technical Specifications & Data Sheet for CI Injection Skid & Equipment

<table>
<thead>
<tr>
<th>S No</th>
<th>Description</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>CI Stock Tank</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Numbers</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>Type</td>
<td>[Vendor to specify]</td>
</tr>
<tr>
<td>1.3</td>
<td>Effective Capacity</td>
<td>[Equal or more to 7 days quantity at the indicated level of dozing for the pipeline(s)]</td>
</tr>
<tr>
<td>1.4</td>
<td>MOC</td>
<td>SS-316</td>
</tr>
<tr>
<td>1.5</td>
<td>Dimensions</td>
<td>[Vendor to specify]</td>
</tr>
<tr>
<td>2.0</td>
<td>CI Dozing Pump</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Number</td>
<td>1 Running + 1 Standby</td>
</tr>
<tr>
<td>2.2</td>
<td>Type</td>
<td>Hydraulic Actuated Flat Diaphragm Metering Pump as per API 675</td>
</tr>
<tr>
<td>2.3</td>
<td>Turndown</td>
<td>10:1</td>
</tr>
<tr>
<td>2.4</td>
<td>Accuracy</td>
<td>± 1%</td>
</tr>
<tr>
<td>2.5</td>
<td>Suction</td>
<td>Flooded</td>
</tr>
<tr>
<td>2.5</td>
<td>Operating Pressure</td>
<td>Vendor to Indicate [Pls see design pressure of piping system and operating fluid pressure at Annexure-A but Minimum 100 bar]</td>
</tr>
<tr>
<td>2.6</td>
<td>Pumping Rate</td>
<td>Intended Dozing rate at 40% - 60% capacity range @ the intended dosing rate for the pipeline gas / LPG flow indicated at Annexure-A</td>
</tr>
<tr>
<td>2.7</td>
<td>MOC</td>
<td>Wetend: 316SS, 316SSL, Alloy C, Monel, Nickel, PVC, PTFE, Polypropylene Diaphragm: PTFE, PFA, Metallic</td>
</tr>
<tr>
<td>3.0</td>
<td>Tubing / Valves / appurtenances / Instruments / Gauges / Skid</td>
<td>Complete Assembly in tested for rated pressure and function, ready to commission state with adequate commissioning spares. [All components other than skid/frame to be SS316 or equivalent CRA]</td>
</tr>
</tbody>
</table>
**Annexure-D**

Minimum Technical Specifications & Data Sheet for CI Injection Quills & Access Fittings

<table>
<thead>
<tr>
<th>S No</th>
<th>Description</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Access Fitting Assembly</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Mounting (GAIL to Confirm)</td>
<td>ASME/ANSI Flange RF for conventional installation</td>
</tr>
<tr>
<td>1.1</td>
<td>Mounting (GAIL to Confirm)</td>
<td>Flare weld with integral branch reinforcement for Hot-tapping installation</td>
</tr>
<tr>
<td>1.2</td>
<td>Size</td>
<td>2” x Height Vendor to Confirm</td>
</tr>
<tr>
<td>1.3</td>
<td>Type</td>
<td>High Pressure Retrievable</td>
</tr>
<tr>
<td>1.4</td>
<td>Material</td>
<td>ASTM A105</td>
</tr>
<tr>
<td>1.5</td>
<td>Rating</td>
<td>6000 psi</td>
</tr>
<tr>
<td>1.6</td>
<td>Connection</td>
<td>Internal ACME Thread</td>
</tr>
<tr>
<td>1.7</td>
<td>Retaining Cover</td>
<td>High Pressure 10000 psi with gauge and bleed</td>
</tr>
<tr>
<td>1.8</td>
<td>Material</td>
<td>ASTM A105</td>
</tr>
<tr>
<td>1.9</td>
<td>Rating</td>
<td>6000 psi</td>
</tr>
<tr>
<td>1.10</td>
<td>Retaining Cover</td>
<td>High Pressure 10000 psi with gauge and bleed</td>
</tr>
<tr>
<td>1.11</td>
<td>Side Tee</td>
<td>3/4” with Socket Weld type injection connection</td>
</tr>
<tr>
<td>2.0</td>
<td>Solid Plug Assembly</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Type</td>
<td>Solid Plug</td>
</tr>
<tr>
<td>2.2</td>
<td>Material</td>
<td>AISI 316</td>
</tr>
<tr>
<td>2.3</td>
<td>Sealing</td>
<td>Viton ‘O’ ring and Teflon primary packing</td>
</tr>
<tr>
<td>2.4</td>
<td>Plug Weight</td>
<td>Vendor to Confirm</td>
</tr>
<tr>
<td>3.0</td>
<td>Injection Nut Assembly</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Nut Size</td>
<td>Vendor to confirm</td>
</tr>
<tr>
<td>3.2</td>
<td>Length</td>
<td>Vendor to confirm</td>
</tr>
<tr>
<td>3.3</td>
<td>Material</td>
<td>Duplex Stainless Steel, O ring: Viton (EDR)</td>
</tr>
<tr>
<td>3.4</td>
<td>Integral Check Valve</td>
<td>Required</td>
</tr>
<tr>
<td>4.0</td>
<td>Injection Tube &amp; Head With Atomization Nozzle</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Tube Size</td>
<td>¾” NPT</td>
</tr>
<tr>
<td>4.2</td>
<td>Tube Material</td>
<td>Duplex Stainless Steel</td>
</tr>
<tr>
<td>4.3</td>
<td>Wake Frequency Calculation</td>
<td>Required ; By Vendor</td>
</tr>
<tr>
<td>4.4</td>
<td>Nozzle</td>
<td>¾” NPT Atomization Nozzle; Parallel to flow</td>
</tr>
<tr>
<td>4.5</td>
<td>Injection</td>
<td>Center of line</td>
</tr>
<tr>
<td>4.6</td>
<td>Orifice Dia</td>
<td>Vendor to confirm suiting to Dozing Requirement (GAIL to approve)</td>
</tr>
<tr>
<td>4.7</td>
<td>Spray Angle</td>
<td></td>
</tr>
<tr>
<td>4.8</td>
<td>Capacity</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>Nipple and Shutoff Valve</td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Size / Length / Grade / Schedule</td>
<td>¾” / 5” / SS 316L / S80</td>
</tr>
<tr>
<td>5.2</td>
<td>Valve Type</td>
<td>¾”Double Block and Bleed Shut off valve SS 316L</td>
</tr>
</tbody>
</table>

**Rev. No.** | **Report No.** | **Issue Date** | **Page 27 of 41**
### Minimum Technical Specifications & Data Sheet for Access Fitting and Corrosion Coupon

<table>
<thead>
<tr>
<th>S No</th>
<th>Description</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>CML* DETAILS</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>CML Id</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>1.2</td>
<td>Pipeline Code &amp; Name</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>1.3</td>
<td>CML Orientation</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>1.4</td>
<td>Design Pressure of CML Pipe</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>1.5</td>
<td>CML Pipe Grade</td>
<td>[GAIL to specify]</td>
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<tr>
<td>2.0</td>
<td>Mass Loss Coupon</td>
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</tr>
<tr>
<td>2.1</td>
<td>Coupon Size</td>
<td>1.25 “OD x 1/8”Thick</td>
</tr>
<tr>
<td>2.2</td>
<td>Coupon Material</td>
<td>Equivalent to Pipe Grade @1.5 – Vendor to Confirm</td>
</tr>
<tr>
<td>2.3</td>
<td>Type</td>
<td>Flush Disc, Retrievable – Vendor to Confirm</td>
</tr>
<tr>
<td>2.4</td>
<td>Mounting</td>
<td>One Hole, 0.312”ID</td>
</tr>
<tr>
<td>2.5</td>
<td>Finish</td>
<td>Ground 120 Grit</td>
</tr>
<tr>
<td>2.6</td>
<td>Coupon Weight</td>
<td>By Vendor</td>
</tr>
<tr>
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<td>Coupon Holder</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Type</td>
<td>Retrieval, Flush Disc Holder, Fixed Length</td>
</tr>
<tr>
<td>3.2</td>
<td>Body Material</td>
<td>AISI 316</td>
</tr>
<tr>
<td>3.3</td>
<td>Weight, g</td>
<td>Vendor to Confirm</td>
</tr>
<tr>
<td>3.4</td>
<td>Extended Stem required?</td>
<td>GAIL to specify</td>
</tr>
<tr>
<td>3.5</td>
<td>Wake Frequency Calculation</td>
<td>Vendor to Confirm (if yes at 2.5)</td>
</tr>
<tr>
<td>4.0</td>
<td>Plug</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Type</td>
<td>Solid Plug</td>
</tr>
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<td>4.2</td>
<td>Material</td>
<td>AISI 316</td>
</tr>
<tr>
<td>4.3</td>
<td>Sealing</td>
<td>Viton ‘O’ ring and Teflon primary packing</td>
</tr>
<tr>
<td>4.4</td>
<td>Coupon Attachment</td>
<td>Single flat head machine screw type with Teflon insulation</td>
</tr>
<tr>
<td>4.5</td>
<td>Plug Weight</td>
<td>Vendor to Confirm</td>
</tr>
<tr>
<td>5.0</td>
<td>Access Fitting</td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Mounting</td>
<td>Flare weld with integral branch reinforcement</td>
</tr>
<tr>
<td>5.2</td>
<td>Type</td>
<td>Non Tee, High Pressure Retrievable</td>
</tr>
<tr>
<td>5.3</td>
<td>Size</td>
<td>2”x 5 ½” Height</td>
</tr>
<tr>
<td>5.4</td>
<td>Material</td>
<td>ASTM A105</td>
</tr>
<tr>
<td>5.5</td>
<td>Rating</td>
<td>6000 psi</td>
</tr>
<tr>
<td>5.6</td>
<td>Connection</td>
<td>Internal ACME Thread</td>
</tr>
<tr>
<td>5.7</td>
<td>Retaining Cover</td>
<td>High Pressure 10000 psi with gauge and bleed</td>
</tr>
<tr>
<td>6.0</td>
<td>Testing</td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>Test Pressure</td>
<td>1.5 times Design Pressure</td>
</tr>
</tbody>
</table>

**Notes:**
* Condition Monitoring Location (CML) is the location on GAIL pipeline / piping where Access Fitting for probe/coupon shall be installed.
1. If only coupon is being procured, strike out all other sections(Coupon Holder, Access Fitting etc.)
2. Temperature rating of all components shall be -15°C to 201°C
4. Holder Sizing shall be done by vendor
5. Coupons shall be packed individually and packaging shall be suitable for minimum one year before use
6. Sup parts mentioned in the datasheets are indicative; vendor to supply all necessary components and spares for making the unit whole.

Annexure-E (1/2)

Minimum Technical Specifications & Data Sheet for Access Fitting and ER Probe

<table>
<thead>
<tr>
<th>S No</th>
<th>Description</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>CML* DETAILS</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>CML Id</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>1.2</td>
<td>Pipeline Code &amp; Name</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>1.3</td>
<td>CML Orientation</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>1.4</td>
<td>Design Pressure of CML Pipe</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>1.5</td>
<td>CML Pipe Grade</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>2.0</td>
<td>ER Probe</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Probe Type</td>
<td>High Pressure Flush,Retrievable</td>
</tr>
<tr>
<td>2.2</td>
<td>Probe Material</td>
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</tr>
<tr>
<td>2.3</td>
<td>Probe Length</td>
<td>Vendor to calculate as per details given</td>
</tr>
<tr>
<td>2.4</td>
<td>Extended Probe Length reqd?</td>
<td>[GAIL to specify]</td>
</tr>
<tr>
<td>2.5</td>
<td>Wake Frequency Calc reqd?</td>
<td>Vendor to calculate as per details given</td>
</tr>
<tr>
<td>2.6</td>
<td>Element Material</td>
<td>Equivalent to Pipe Grade given at 1.5 above – Vendor to confirm</td>
</tr>
<tr>
<td>2.7</td>
<td>Element Thickness</td>
<td>10 Mils (for 5 Mils useful life)</td>
</tr>
<tr>
<td>3.0</td>
<td>Plug</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Type</td>
<td>Solid Plug</td>
</tr>
<tr>
<td>3.2</td>
<td>Material</td>
<td>AISI 316</td>
</tr>
<tr>
<td>3.3</td>
<td>Sealing</td>
<td>Viton ‘O’ ring and Teflon primary packing</td>
</tr>
<tr>
<td>3.4</td>
<td>Plug Weight</td>
<td>Vendor to Confirm</td>
</tr>
<tr>
<td>4.0</td>
<td>Access Fitting</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Mounting</td>
<td>Flare weld with integral branch reinforcement</td>
</tr>
<tr>
<td>4.2</td>
<td>Type</td>
<td>Non Tee, High Pressure Retrievable</td>
</tr>
<tr>
<td>4.3</td>
<td>Size</td>
<td>2”x 5 ¾” Height</td>
</tr>
<tr>
<td>4.4</td>
<td>Material</td>
<td>ASTM A105</td>
</tr>
<tr>
<td>4.5</td>
<td>Rating</td>
<td>6000 psi</td>
</tr>
<tr>
<td>4.6</td>
<td>Connection</td>
<td>Internal ACME Thread</td>
</tr>
<tr>
<td>4.7</td>
<td>Retaining Cover</td>
<td>High Pressure 10000 psi with gauge and bleed</td>
</tr>
<tr>
<td>5.0</td>
<td>Testing</td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Test Pressure</td>
<td>1.5 times Design Pressure</td>
</tr>
</tbody>
</table>

Notes:
* Condition Monitoring Location (CML) is the location on GAIL pipeline / piping where Access Fitting for probe/coupon shall be installed.
1. If only probe is being procured, strike out all other sections (Coupon Holder, Access Fitting etc.)
2. Temperature rating of all components shall be -15°C to 201°C
4. Probe Assembly Sizing shall be done by vendor
5. Probes shall be packed individually and packaging shall be suitable for minimum one year before use
6. Sup parts mentioned in the datasheets are indicative; vendor to supply all necessary components and spares for making the unit whole.
7. Hand Held Unit, Data Logger and / or Transmitter as per technical specification shall be supplied (if applicable) as per Purchase Order
A Corrosion Inhibitor contains one or more inhibitors, surfactants, and solvents. Laboratory tests, field tests, industry experience, and inhibitor manufacturer's recommendations are essential to their effectiveness, compatibility, or required injection rates. The inhibitor intended for this application is an imidazoline type and dispersible in water and soluble in hydrocarbons, thus permitting protection of pipes.

1.0 The following are the minimum technical requirements for the CI to be selected and applied under the scope of this contract:

1.1 The predominant corrosion mechanism is expected to be sweet corrosion (CO₂) and in some cases due to H₂S in the range of 5-15 ppm.

1.2 The objective of Corrosion Inhibitor injection is to reduce the uninhibited Corrosion Rate in Carbon Steel pipeline in excess of 2 mpy (the maximum expected in NG / LPG application in GAIL operations is 5 mpy) to within 1 mpy. In cases where CI application is required in pipelines having low Corrosion Rate below 2 mpy, the required inhibited rate shall be at least 50% less than the uninhibited rate.

1.3 Corrosion Inhibitor dosage rate: Both "Minimum Effective Concentration" and "Maximum allowable dosage rate" of proposed corrosion inhibitor shall not be more than 50 ppmv and not less than 15 ppmv. Therefore, bidder shall accordingly quote for the dosage rates of the corrosion inhibitor of this specification.

1.4 The Corrosion Inhibition efficiency required shall be in excess of 90% at an availability for more than 95% of the time.

1.5 Type: The corrosion inhibitor shall be Hydrocarbon / LPG Soluble Water dispersible type.

1.6 The offered CI shall be environmentally benign and biodegradable.

1.7 Physical Properties: Material shall be free flowing homogeneous liquid at 24 ± 2°C, free from visible impurities having following physical properties:

- Viscosity at 25 °C ≤ 50 cSt
- Pour Point - 18 °C max
- Flash Point > 45 °C

1.8 Compatibility: The dosing of corrosion inhibitor, in no case should affect the quality of the fluid (NG / LPG) being transported in pipelines and nor react with the pipeline material (API SL grade) of cross country pipelines. The corrosion inhibitor shall be suitable for
continuous inhibitor application in NG / LPG cross country transmission pipelines. Characteristics of NG / LPG transported through the said pipeline in which corrosion inhibitor will be injected are given at Annexure-B1/B2. The gas / LPG transported by GAIL pipelines are being consumed by customers for use as fuel or as feed stock in manufacture of fertilizers and chemicals. Hence the injected CI shall in no way impact the materials or processes of the downstream industries.

1.9 Water content in NG / LPG is normally nil. However occasionally there may be some minor presence of water in LPG pipeline.

2.0 The candidate Corrosion Inhibitor offered by the bidder shall be subjected to series of laboratory tests prior to field trial. These tests shall be termed as “Qualification Tests”.

2.1 Name / Details of at least three laboratories having the capability to conduct the tests mentioned herein shall be provided by each bidder. GAIL shall review the list provided by all the bidders during techno-commercial stage and the list of approved laboratories which may or may not include the labs mentioned by a specific bidder, shall be circulated to all the participating bidders for their confirmation to accept cost of laboratory testing up to three parallel & identical testing at different laboratories. Only bids of those bidders consenting to the third party testing costs shall be qualified for price bid opening.

2.2 Same set of tests will be conducted in two laboratories and in case of non-agreement, will be tested at one more laboratory.

2.3 The samples of required quantities for testing shall be given by Contractor free of costs for all the required tests.

2.4 These tests shall include but limited to the following:

2.4.1 **High Temperature and High Pressure Rotating Cage Autoclave (RCA) Test:** Test must be conducted in stirred or rotating HT (High Temperature) & HP (High Pressure) Autoclaves to mimic the pipeline operating conditions. General corrosion rate shall be calculated as per weight loss measurement method. The test conditions have been indicated below. Corrosion Inhibitors shall provide a minimum protection of 90% (Corrosion rates less than 1 mpy) at minimum effective concentration i.e., ‘Specified Injection Rate’. This test will assess CI performance under very high shear conditions.

\[
\% \text{ Protection} = \frac{mg \text{ blank mass loss} - mg \text{ test specimen loss}}{mg \text{ blank mass loss}} \times 100
\]

- Applicable Standards:
Corrosion Inhibitor: Selection, Testing, Application & Performance

**Title**

Corrosion Inhibitor: Selection, Testing, Application & Performance

**Type**

Guidance Document

**Reference No.**

CIMG-GD-5-2017-0001


- **Test Temperature**: 35 °C
- **Test Pressure**: 50 kg/cm² – Pressure can be maintained by using Nitrogen or CO₂ or combination of both.
- **Test Medium**: 20% Synthetic Hydrocarbon or Naphtha + 80% Brine
- **Corrosion Inhibitor dosage** (*Specified Injection Rate*): As proposed by Bidder
- **RPM/Stir Rate**: rpm of rotating cage in test should be such that it is sufficient to create the highest wall shear stress as per clause no. 2.4.11 below. All the values of shear stress shall be calculated and reported to substantiate that highest value has been used for the test. Selected rpm shall be reported.
- **Sample washing / cleaning**: Cleaning of metal coupon shall be done as per ASTM G 1. Solution with Designation C.3.1 (Clark’s solution = 1000 mL HCl + 20g Sb₂O₃ + 50g SnCl₂) will be used for cleaning the metal coupon. Each coupon shall be cleaned with solution for 5 minutes.

2.4.2 Rotating Cell Electrode (RCE) Linear Polarization Resistance (LPR) Testing: The rotating cylinder electrode (RCE) tests should be conducted in Pyrex glass reaction kettles that are continuously purged with N₂ or CO₂ both and heated to 35°C. The testing solution should be de-aerated for approximately four hours prior to inserting the working electrodes. Linear polarization resistance (LPR) measurements should be made with a Gamry electrochemical measurement system. The corrosion inhibitor should be added at the *Specified Injection Rate* (or minimum effective concentration) proposed by bidder based on the total fluid volume after the baseline corrosion rate is monitored. Corrosion Inhibitors shall provide a minimum protection of 90% at the *Specified Injection Rate* (minimum effective concentration). This test will assess CI performance under moderate flow conditions.

- **Applicable Standards**:
  - **Test Temperature**: 35°C
  - **Test Medium**: 20% Synthetic Hydrocarbon (like LVT-200 synthetic hydrocarbon or
naphtha) + 80% Brine or Synthetic Brine

- Corrosion Inhibitor dosage (‘Specified Injection Rate’ or minimum effective concentration): As proposed by bidder.
- RPM/ Stir Rate: rpm of rotating cage in test should be such that it is sufficient to create the highest wall shear stress. All the values of shear stress shall be calculated and reported to substantiate that highest value has been used for test. Selected rpm value shall also be reported.
- Sample washing / cleaning: - Cleaning of metal coupon shall be done as per ASTM G1. Solution with Designation C.3.1 (Clark's solution = 1000 mL HCl + 20 g Sb₂O₃ +50g SnCl₂) will be used for cleaning the metal coupon. Each coupon shall be cleaned with solution for 5 minutes.

2.4.3 Thermal Stability Test: The offered Corrosion Inhibitor shall be thermally stable up to the temperature of 60 ± 2 °C.

- Applicable Standards:
- Thermal Stability testing shall be carried out over the course of five days at the aforesaid temperature.
- FTIR spectroscopy of the samples before and after test shall be compared to ascertain any change in stability of the Corrosion Inhibitor.
- Corrosion Inhibitors shall be thermally stable over this period. Visual Inspection of the inhibitor for the appearance of decomposition, gunking and polymerization etc. shall be done

2.4.4 Oil Water Partitioning Test: Oil water partitioning characteristics of the corrosion inhibitor shall be performed in accordance with method described in ASTM G 170.

- Applicable Standards:
- Corrosion Inhibitor dosage (‘Specified Injection Rate’ or minimum effective concentration): As proposed by bidder.
- The performance tests conducted should be carried out with synthetic
hydrocarbon / naphtha present to show how well the product partitions as the water cut decreases.

- Water cut percentages like 5%, 2% & 0.5% shall be used with oil / synthetic hydrocarbon.
- **Corrosion Inhibitor** shall preferentially partition into the water phase as the water cut reduces.
- **Ratio of Inhibitor** seen in oil phase to seen in water phase shall be reported.

### 2.4.5 Foaming Tendency Test

The foaming tendency of the corrosion inhibitor shall be evaluated as per ASTM G 170. A solution consisting of 100 mL hydrocarbon and 100 mL brine, dosed with twice the minimum effective concentration (‘Specified Injection Rate’) of corrosion inhibitor shall be used for testing. This solution shall be sparged with gas like Nitrogen (N₂) at a constant rate of 1 Litre per minute for one minute to produce foam. The height of the foam and the time of dissipation shall be recorded. **Corrosion Inhibitors shall not cause any foaming of the solution.**

### 2.4.6 Emulsification tendency

Emulsion-forming tendency test shall be carried out for inhibited samples in accordance with ASTM G 170 or any other applicable standards. NaCl brine and hydrocarbon (like LVT -200 synthetic hydrocarbon) should be added in a 1:1 ratio to a graduated torpedo tube to assess the emulsion tendency with each product. The inhibitor should be dosed at various rates based on total fluid volume and mixed by vigorous shaking. The interface between the brine and hydrocarbon phases should be observed and phase separation recorded at intervals of 30 seconds up to 10 minutes. Water quality should be observed over time and compared with a blank test containing no chemical. **Corrosion Inhibitors shall not cause any emulsion formation in the solution.**

### 2.4.7 Fourier Transform Infra-Red (FTIR) Spectroscopy

The vendor shall be required to furnish electronic copy of FTIR spectroscopy of the offered corrosion inhibitor.

### 2.4.8 Storage stability

The corrosion inhibitor when stored for a minimum 12 months in manufacturer supplied containers at ambient outdoor conditions in a temperate climate, the inhibitor shall show no precipitation, layering, or other evidence of gross separation or degradation. Additive that represents the top-half of the stored sample shall meet all requirements of this specification. As far as possible, upon delivery of product, the same shall be stored under shaded area.

### 2.4.9 Toxicity/environmental friendliness

Test shall be carried out as per ASTM G 170. The corrosion inhibitor shall have no adverse effect on the health of personnel and environment when used for its intended purpose. MSDS (Material Safety Data Sheet) of
Corrosion Inhibitor shall be submitted in line with International Standards (like Reach) declaring all hazardous components of CI.

2.4.10 **Viscosity**: Viscosity of proposed corrosion inhibitor shall be measured at 25°C as per ASTM D 445 / ASTM D2170 / ASTM D88 (as applicable and shall be ≤ 50 cSt.

2.4.11 **Density**: Density (@ 15°C) of the CI shall be measured as per ASTM D4052 / ASTM D1217 (as applicable).

2.4.12 **Pour Point**: Pour Point (°C) shall be measured as per ASTM D97.

2.4.13 **Flash Point**: Flash Point (°C) shall be measured as per ASTM D 93 – PMCC Test / IP -170 – Abel Test / ASTM D 92 (as applicable).

2.4.14 **Shear Stress** (RPM) for RCA & RCE tests: Vendor shall calculate all the shear values for the combinations in table below. All the values shall be reported in test report to substantiate that highest shear value has been selected by vendor for the applicable tests:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Pipeline [Name]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline Diameter</td>
<td>Inch</td>
<td></td>
</tr>
<tr>
<td>Pipeline Flow Rate</td>
<td>Actual m³/h</td>
<td></td>
</tr>
</tbody>
</table>

3.0 **Conformance Tests:**

3.1 After successful qualification of Candidate Corrosion Inhibitors of the selected agency, the supplied chemicals shall be continued to be tested at any of the listed labs for each batch of chemicals supplied. Cost of testing shall be borne by Contractor. GAIL shall have access to witnessing of these tests. These tests shall be termed as “Conformance Tests”.

3.2 Quality Conformance inspection of a bulk lot prior to becoming a packaged lot shall comprise the tests given below as per method indicated at 2.0 above:

   a) Fourier Transform Infra-red (FTIR) Spectroscopy
   b) Density
   c) Viscosity
   d) Pour Point
   e) Flash Point

3.3 A bulk lot is defined as an indefinite quantity of a homogenous mixture of material offered for acceptance in a single, isolated container manufactured through the same
processing equipment with no change in ingredient material. A packaged lot is defined as an indefinite number of small size drums or smaller unit packages of identical size and type or an indefinite number of larger size returnable containers offered for acceptance and filled with a homogenous mixture of material from a bulk lot.

3.4 Each bulk or packaged lot of material should be sampled for verification of product quality and compliance in accordance with ASTM D 4057.

3.5 Contractor shall take back the empty inhibitor containers at their own cost from the location of supply/application of CI for safe and environmental friendly disposal.

3.6 GAIL reserves the right to perform Qualification or Conformance Tests after supply and if material does not meet the requirements such lot of material shall be rejected. Contractor at their own cost shall take back their material rejected so.

4.0 SUBMITTALS

Documents to be submitted along with the bid:

4.1 Test Reports for the particular CI offered on the tests listed under 2.0 in case such tests have been carried out within 2 year prior to the date of tender for supply to GAIL or any of the Central PSUs as per test methods described above. In such case, GAIL may not require Qualification tests afresh for such CI.

4.2 Product Date Sheet (PDS) of the offered Corrosion Inhibitor

4.2.1 Material Safety Data Sheet (MSDS) of the offered Corrosion Inhibitor. MSDS must mention all the chemical ingredients of the CI with CAS Number.

4.2.2 FTIR spectroscopy report of the proposed corrosion inhibitor.

4.2.3 Details of Purchase Orders executed in the last 7 years for the bulk supply of the offered Corrosion Inhibitor to NG / LPG pipeline operators shall be provided with the bid. Performance certifications and client reference may also be furnished.
Annexure-G

LIST OF LABORATORIES FOR TESTING OF CORROSION INHIBITORS

[To be furnished by Bidder]

<table>
<thead>
<tr>
<th>S No</th>
<th>Name &amp; Address of the Lab</th>
<th>Name, Telephone No., Mobile No, &amp; email of the Contact Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
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<td>4</td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Authorised Signatory)
Annexure-H

Details of CI Injection facilities if already available at GAIL Location
[To be furnished by GAIL]
### Schedule of Rates – Group A

**Design, Supply, Installation and Commissioning of Corrosion Inhibitor (CI) Injection System.**

<table>
<thead>
<tr>
<th>SOR No</th>
<th>Description</th>
<th>UOM</th>
<th>QTY</th>
<th>Rate (INR)</th>
<th>Amount (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Design, Supply, Installation and Commissioning of Corrosion Injection System meeting the requirements given in Scope of Work, Specifications and Special Conditions of Contract – Other than supply &amp; installation of Access fittings, injection quills and corrosion monitoring ER probes.</td>
<td>LS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Supply and installation of Access fittings and Injection Quills by hot-tapping on the existing GAIL pipeline installation including welding of weldolets online with pre and post NDT.</td>
<td>Per Set</td>
<td>[concerned RIMG to mention quantity]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Supply and installation of Access fittings and ER Probes &amp; Transmitter by hot-tapping on the existing GAIL pipeline installation including welding of weldolets online with pre and post NDT.</td>
<td>Per Set</td>
<td>[concerned RIMG to mention quantity]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total – Group A**
# Schedule of Rates – Group B

## Supply and Application of Corrosion Inhibitor (CI)

<table>
<thead>
<tr>
<th>SOR No</th>
<th>Description</th>
<th>UOM</th>
<th>Qty</th>
<th>Rate (INR)</th>
<th>Amount (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group – B:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Supply and Application of CI at GAIL Installation for the specified lines at the Specified dosage rate including arrangement of local warehouse, transportation to warehouse and thereon to GAIL installation, storage, preparation / blending and transfer to day tanks, monitoring &amp; control of dozing operations and corrosion rate as per the Scope of Work, Specifications and Special conditions of Contract. Bidder shall quote rate per kg of CI to be applied on a continuous basis. Quantity indicated is total quantity for ___ years to be billed and paid on monthly basis as per Payment Terms given in contract.</td>
<td>Kg</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

**Total – Group B**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Total in Figures (INR)</th>
<th>Total in Words (INR)</th>
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<tbody>
<tr>
<td><strong>Total Group A</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Total Group B</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td></td>
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</table>