



Extension of due date for Eoi

Subject: Expression of Interest for Technology tie-up for 155 mm / 52 Caliber Mounted Gun System (MGS)

This has reference to the Expression of Interest (Eoi) published on BHEL's website i.e. www.bhel.com Ref No.: BHEL/AA/TL/0203 dated July 28, 2023, seeking interest from OEMs willing to be associated with Bharat Heavy Electricals Limited (BHEL) through a Technology Collaboration Agreement (TCA) to design develop, engineer, manufacture, assemble, test, integrate, commission, maintain, operate, repair, overhaul/retrofit, service, troubleshoot and sell 155 mm /52 Caliber Mounted Gun System (MGS) to meet Indian Army (IA)/ Ministry of Defence (MoD) requirements.

The due date for receiving the proposals against the Eoi has now been extended up to **November 30, 2023 (Thursday)**.

The interested Prospective Collaborator (s) shall ensure that their response, along with details requested as per the Annexures of this Eoi, is received by BHEL on or before **November 30, 2023 (Thursday)**. The response(s) shall necessarily be accompanied with details on company background, technical features/ product catalogue, reference list, annual audited financial reports for last 3 (three) years including auditor's report and other enclosures as required under the present Eoi.

Contact details for submission of response and for seeking clarifications are as below:

Senior Deputy General Manager (CTM)

Corporate Technology Management,
Bharat Heavy Electricals Limited (BHEL),
BHEL House, Siri Fort, New Delhi 110049
Tel: +91-11- 66337213 / 66337339
Mobile: +91 7838293011
E-Mail: techeoi@bhel.in



Extension of due date for Eoi

Subject: Expression of Interest for Technology tie-up for 155 mm / 52 Caliber Mounted Gun System (MGS)

This has reference to the Expression of Interest (Eoi) published on BHEL's website i.e. www.bhel.com Ref No.: BHEL/AA/TL/0203 dated July 28, 2023, seeking interest from OEMs willing to be associated with Bharat Heavy Electricals Limited (BHEL) through a Technology Collaboration Agreement (TCA) to design develop, engineer, manufacture, assemble, test, integrate, commission, maintain, operate, repair, overhaul/retrofit, service, troubleshoot and sell 155 mm /52 Caliber Mounted Gun System (MGS) to meet Indian Army (IA)/ Ministry of Defence (MoD) requirements.

The due date for receiving the proposals against the Eoi has now been extended up to **October 31, 2023 (Tuesday)**.

The interested Prospective Collaborator (s) shall ensure that their response, along with details requested as per the Annexures of this Eoi, is received by BHEL on or before **October 31, 2023 (Tuesday)**. The response(s) shall necessarily be accompanied with details on company background, technical features/ product catalogue, reference list, annual audited financial reports for last 3 (three) years including auditor's report and other enclosures as required under the present Eoi.

Contact details for submission of response and for seeking clarifications are as below:

Senior Deputy General Manager (CTM)

Corporate Technology Management,
Bharat Heavy Electricals Limited (BHEL),
BHEL House, Siri Fort, New Delhi 110049
Tel: +91-11- 66337213 / 66337339
Mobile: +91 7838293011
E-Mail: techeoi@bhel.in



Extension of due date for Eoi

Subject: Expression of Interest for Technology tie-up for 155 mm / 52 Caliber Mounted Gun System (MGS)

This has reference to the Expression of Interest (Eoi) published on BHEL's website i.e. www.bhel.com Ref No.: BHEL/AA/TL/0203 dated July 28, 2023, seeking interest from OEMs willing to be associated with Bharat Heavy Electricals Limited (BHEL) through a Technology Collaboration Agreement (TCA) to design develop, engineer, manufacture, assemble, test, integrate, commission, maintain, operate, repair, overhaul/retrofit, service, troubleshoot and sell 155 mm /52 Caliber Mounted Gun System (MGS) to meet Indian Army (IA)/ Ministry of Defence (MoD) requirements.

The due date for receiving the proposals against the Eoi has now been extended up to **September 22, 2023 (Friday)**.

The interested Prospective Collaborator (s) shall ensure that their response, along with details requested as per the Annexures of this Eoi, is received by BHEL on or before **September 22, 2023 (Friday)**. The response(s) shall necessarily be accompanied with details on company background, technical features/ product catalogue, reference list, annual audited financial reports for last 3 (three) years including auditor's report and other enclosures as required under the present Eoi.

Contact details for submission of response and for seeking clarifications are as below:

Senior Deputy General Manager (CTM)

Corporate Technology Management,
Bharat Heavy Electricals Limited (BHEL),
BHEL House, Siri Fort, New Delhi 110049
Tel: +91-11- 66337213 / 66337339
Mobile: +91 7838293011
E-Mail: techeoi@bhel.in



Extension of due date for Eoi

Subject: Expression of Interest for Technology tie-up for 155 mm / 52 Caliber Mounted Gun System (MGS)

This has reference to the Expression of Interest (Eoi) published on BHEL's website i.e. www.bhel.com Ref No.: BHEL/AA/TL/0203 dated July 28, 2023, seeking interest from OEMs willing to be associated with Bharat Heavy Electricals Limited (BHEL) through a Technology Collaboration Agreement (TCA) to design develop, engineer, manufacture, assemble, test, integrate, commission, maintain, operate, repair, overhaul/retrofit, service, troubleshoot and sell 155 mm /52 Caliber Mounted Gun System (MGS) to meet Indian Army (IA)/ Ministry of Defence (MoD) requirements.

The due date for receiving the proposals against the Eoi has now been extended up to **August 31, 2023 (Thursday)**.

The interested Prospective Collaborator (s) shall ensure that their response, along with details requested as per the Annexures of this Eoi, is received by BHEL on or before **August 31, 2023 (Thursday)**. The response(s) shall necessarily be accompanied with details on company background, technical features/ product catalogue, reference list, annual audited financial reports for last 3 (three) years including auditor's report and other enclosures as required under the present Eoi.

Contact details for submission of response and for seeking clarifications are as below:

Senior Deputy General Manager (CTM)

Corporate Technology Management,
Bharat Heavy Electricals Limited (BHEL),
BHEL House, Siri Fort, New Delhi 110049
Tel: +91-11- 66337213 / 66337339
Mobile: +91 7838293011
E-Mail: techeoi@bhel.in



Bharat Heavy Electricals Limited

(A Government of India Undertaking)

Delhi – 110 049

India

Notice for inviting

Expression of Interest for Technology tie-up for 155 mm / 52 Caliber Mounted Gun System (MGS)

Eoi Ref No.: BHEL/AA/TL/0203

Date: 28 July, 2023

INDEX

Sl. No.	DESCRIPTION
1.	Section 1: Disclaimer
2.	Section 2: Schedule of Expression of Interest (Eoi) process & contact details
3.	Section 3: Details of Expression of Interest (Eoi)
4.	Annexure-1: Indicative Scope of Technology Transfer
5.	Annexure-2: Prospective Collaborator's response on proposal for Technology tie-up for 155 mm /52 Caliber Mounted Gun System
6.	Annexure-3: Questionnaire on various technical specifications & parameters of 155 mm / 52 Caliber Mounted Gun System

SECTION-1

Disclaimer

The information contained in this Expression of Interest (Eol) document provided to the Prospective Collaborator(s), by or on behalf of Bharat Heavy Electricals Limited (BHEL) or any of its employees or advisors, is provided to the Prospective Collaborator(s) on the terms and conditions set out in this Eol document and all other terms and conditions subject to which such information is provided.

1. The purpose of this Eol document is to provide the Prospective Collaborator(s) with information to assist the formulation of their proposal. This Eol document does not purport to contain all the information each Prospective Collaborator may require. This Eol document may not be appropriate for all persons, and it is not possible for BHEL, its employees or advisors to consider the business/investment objectives, financial situation and particular needs of each Prospective Collaborator who reads or uses this Eol document. Each Prospective Collaborator should conduct its own investigations and analysis and should check the accuracy, reliability and completeness of the information in this Eol document and where necessary obtain independent advice from appropriate sources.
2. BHEL, its employees and advisors make no representation or warranty and shall incur no liability under any law, statute, rules or regulations as to the accuracy, reliability or completeness of the Eol document.
3. BHEL may, in its absolute discretion, but without being under any obligation to do so, modify, amend or supplement the information in this Eol document.
4. The issue of this Eol does not imply that BHEL is bound to select and shortlist any or all the Prospective Collaborator(s). Even after selection of suitable Prospective Collaborator, BHEL is not bound to proceed ahead with the Prospective Collaborator and in no case be responsible or liable for any commercial and consequential liabilities in any manner whatsoever.
5. The Prospective Collaborator(s) shall bear all costs associated with the preparation, technical discussion/presentation and submission of response against this Eol. BHEL shall in no case be responsible or liable for these costs regardless of the conduct or outcome of the Eol process.
6. Canvassing in any form by the Prospective Collaborator(s) or by any other agency on their behalf shall lead to disqualification of their Eol.
7. Notwithstanding anything contained in this Eol, BHEL reserves the right to accept or reject any application and to annul the Eol process and reject all applications, at any time without any liability or any obligation for such acceptance, rejection or annulment and without assigning any reasons, thereof. In the event that BHEL rejects or annuls all the applications, it may at its discretion, invite all eligible Prospective Collaborators to submit fresh applications.
8. BHEL reserves the right to disqualify any applicant during or after completion of Eol process, if it is found there was a material misrepresentation by any such applicant or the applicant fails to provide within the specified time, supplemental information sought by BHEL.
9. BHEL reserves the right to verify all statements, information and documents submitted by the applicant in response to the Eol. Any such verification or lack of such verification by BHEL shall not relieve the applicant of his obligations or liabilities hereunder nor will it affect any rights of BHEL.

SECTION-2

Schedule of Expression of Interest (Eoi) Process & Contact Details

2.1 Schedule of Eoi process:

The schedule of activities during the Eoi Process shall be as follows:

Sl. No.	Description	Date
1.	Issue of Eoi document	28 July, 2023
2.	Last date of submission of Eoi response	18 August, 2023

2.2 Contact Details:

Senior Deputy General Manager (CTM)
Corporate Technology Management,
Bharat Heavy Electricals Limited (BHEL),
BHEL House, Siri Fort, New Delhi 110049
Tel: +91-11- 66337213 / 66337339
Mobile: +91 7838293011
E-Mail: techeoi@bhel.in

SECTION – 3

Details of Expression of Interest

3.1 Introduction:

This Expression of Interest (Eoi) seeks responses from Prospective Collaborator (s) who are Original Equipment Manufacturers (OEMs), fulfilling all the requirements of this Eoi and are willing to be associated with Bharat Heavy Electricals Limited (BHEL) through a Technology Collaboration Agreement (TCA) to design (including know-why & know-how, as required), develop, engineer, manufacture, assemble, test, integrate, commission, maintain, operate, repair, overhaul/retrofit, service, troubleshoot and sell 155 mm /52 Caliber Mounted Gun System (MGS) to meet Indian Army (IA)/ Ministry of Defence (MoD) requirements.

3.2 About BHEL:

BHEL is an integrated power plant equipment manufacturer and largest engineering & manufacturing enterprise of its kind in India, catering to core infrastructure sectors of Indian economy viz. energy, transportation, Oil & Gas, heavy engineering industry, renewable & non-conventional energy and defence. BHEL is listed on both major stock exchanges of India (BSE and NSE), wherein Government of India is holding 63.17% of its equity. To position the company as global industrial giant, Government of India categorized BHEL as “**Maharatna Company**” in 2013, empowering the company with enhanced autonomy in decision making.

BHEL has 16 manufacturing units, 4 power sector regions, 8 service centers and 4 regional offices besides a host of project sites spread all over India and abroad. The annual turnover of BHEL for the year 2022-23 was around USD \$2.8 Billion (Rs 23,365 Cr). Highly skilled and committed manpower of approx. 29000 employees, state-of-art manufacturing facilities and technologies have helped BHEL to deliver a consistent track record of performance. With the current order book exceeding US \$ 14 Billion (Rs. 102000 Cr), BHEL is poised for an excellent future growth.

Our ongoing major technology tie-ups include Siemens Energy Global GmbH & Co. KG., Germany (for Steam Turbines, Generators and Condensers); MHI, Japan (for Flue Gas Desulfurization Systems); Leonardo S.p.A, Italy (for Super Rapid Gun Mount); GE Tech. GmbH, Switzerland (for Steam Turbine for Nuclear Power Plant and for Gas Turbines); Vogt Power International, USA (for Heat Recovery Steam Generators); Indian Space Research Organization (ISRO) (for Space Grade Lithium-Ion Cells); CSIR-IIP (PVSA-based Medical Oxygen Plant); NANO Co. Ltd., Korea (for SCR Catalysts); HLB Power Co. Ltd., Korea (for Gates and Dampers); Kawasaki Heavy Industries, Japan (for Stainless Steel Coaches for Metros); Valmet Automation Oy, Finland (for DCS System), Sumitomo SHI FW, Finland (CFBC Boilers) and Babcock Power Environmental Inc., USA (for Selective Catalytic Reduction Systems).

For more details about the entire range of BHEL’s products and operations please visit our website <http://www.bhel.com>.

3.3 BHEL in Defence Sector

BHEL has emerged as a reliable supplier of strategic equipment and services to Indian Defence Forces for over 25 years. BHEL has large infrastructure including dedicated engineering and

manufacturing facilities at many locations to manufacture various types of equipment and provide complete services to meet the Indian Defence requirements. BHEL has supplied 76/62 Super Rapid Gun Mount, Armoured Recovery Vehicles, Simulators, Control System for Tanks, Integrated Platform Management System for Ships, casting and forgings etc to the Defence Forces. Ministry of Defence, Govt. of India has nominated BHEL as the Production Agency for indigenous manufacture of 30 mm Naval Surface Gun in association with selected OEMs under Transfer of Technology. Heavy Electrical Equipment Plant (HEEP), one of the major manufacturing units of BHEL located at Haridwar, Uttarakhand is manufacturing super rapid gun mounts for Indian Navy since 1994.

3.4 Scope of cooperation:

Indian Army (IA) / Ministry of Defence (MoD) is in the process of procurement of Mounted Gun System(MGS) and has indicated a requirement of 155 mm/ 52 Calibre Mounted Gun System (MGS). Request For Proposal (RFP) for procurement of such MGS has been issued by IA/MoD under “Buy (Indian-IDDMM)” category of extant Defence Acquisition Policy (DAP) (DAP copy is available on Ministry of Defence, Govt. of India website <http://mod.nic.in>). As per the “Buy (Indian-IDDMM)” category, MoD procures the tendered equipment from an Indian vendor that have been indigenously designed, developed and manufactured with a minimum of 50% Indigenous Content (IC) on cost basis of the base contract price.

BHEL is seeking interest from Prospective Collaborators for entering into a long term Technology Collaboration Agreement (TCA) with transfer of associated Intellectual Property rights (IPR), if required, to design (including know-why & know-how, as required), develop, engineer, manufacture, assemble, test, integrate, commission, maintain, operate, repair, overhaul/retrofit, service, troubleshoot and sell 155 mm/ 52 Caliber Mounted Gun System (MGS) in India to address the requirement of IA/ MoD. The indicative scope of technology transfer is given at **Annexure-1**.

Based on this Eoi process, BHEL presently intends to shortlist and select suitable partner/s for participation in the above procurement process of IA/ MoD and if successful, will execute the contract(s) for MGS with shortlisted partner(s) after award of contract from IA/MoD. For this purpose, ultimately a long-term Technology Collaboration Agreement as per indicative scope at **Annexure-1** would be signed. Detailed techno-commercial negotiations shall be held with the shortlisted Prospective Collaborator(s) to finalize the long-term TCA with the selected party.

A Memorandum of Understanding (MoU) shall be signed with the selected party before submission of bid against RFP to IA/ MoD. The long-term Technology Collaboration Agreement shall be entered into with the selected party after receipt of contract by BHEL from the IA/ MoD for MGS.

BHEL shall receive applications pursuant to this Eoi in accordance with the terms set forth herein, as modified, altered, amended and clarified from time to time by BHEL, and all Applications shall be prepared and submitted in accordance with such terms on or before the date specified in this Eoi for submission of applications.

Prospective collaborator (s) shall support BHEL in integration of their respective product to enable BHEL supply the complete MGS. Prospective Collaborator shall also support BHEL in system integration including with the in service Fire Control Radar (to be provided by Indian Army) and

proving of the complete system as per RFP parameters.

Prospective Collaborator (s) would be required to successfully meet the Field Evaluation Trials of the MGS to be carried out by IA/ MoD as per terms of DAP and/or RFP. . Salient points pertaining to Field Trials are as given below:

- i. For a Bidder to be accepted/pre-qualified by IA/ MoD it is mandatory that the MGS successfully clears all the tests/trials/evaluations as per IA/ MoD requirements. The trial evaluation process includes but not limited to following activities:
 - a) User trial
 - b) Technical/ Environmental evaluation trial
 - c) Maintainability evaluation trial
 - d) EMI/ EMC evaluation trial
- ii. The prospective collaborator along with BHEL shall be required to provide the desired unit(s) of MGS for Field Evaluation Trials and acceptance by IA/ MoD in varying climatic altitude and terrain conditions in India. A staff evaluation will be carried out by IA/ MoD which will give the compliance of the demonstrated performance of the equipment vis-à-vis the requirements of IA/ MoD.
- iii. Trials will be conducted as per requirements of RFP issued by IA/ MoD. Any modification/ rectification required during the trials to meet IA/ MoD specifications would be carried out by the Prospective Collaborator (s) along with BHEL.
- iv. Prospective Collaborator would be required to jointly manufacture/develop the prototype of MGS and carry out field trials as per IA/MoD requirements of No Cost No Commitment (NC-NC) basis. BHEL may consider sharing the financial burden associated with the NC-NC trials. Details of sharing of such financial burden shall be mutually agreed between the parties. Since BHEL has vast infrastructure and manufacturing facilities spread pan India, may also be used for expediting the manufacturing of prototype or making any modification during trials.
- v. Prospective Collaborator (s) would be required to support BHEL during interactions with the IA/ MoD for initial screening, participation in the RFP and subsequent qualification process by way of deputing their experts to India and providing the required information and clarifications as required/sought by IA/ MoD.
- vi. Prospective Collaborator (s) shall provide firm and irrevocable commitment to provide product support in terms of upgrade, maintenance, materials and spares etc for a minimum period of 25 years from the date of last MGS supplied by BHEL or as required in the RFP issued by IA/ MoD.
- vii. Prospective Collaborator (s) is required to confirm that in case of getting shortlisted as a result of this Eoi process, following support shall necessarily be provided to BHEL in order to enable BHEL to prepare and submit a competitive techno-commercial bid to IA/ MoD as per the terms of the RFP (& other requirements as applicable) and also to successfully execute the contract in case of BHEL emerging as qualified bidder:
 - a. To provide costing elements required for preparation of BHEL offer against RFP. Costing elements to cover the details of major materials used in MGS, manufacturing process,

facilities including major machines, assembly & special test equipment, special processes and other suitable details on shop layouts and any other pertinent details. The information to include known supplier sources for such facilities/equipment.

- b. To provide a price list with long term validity with Price Variation Clause for assemblies/subassemblies/components/spares/Manufacturer's recommended list of Spares (MRLS) etc. for items to be sourced from Prospective Collaborator (s).
- c. Any other requirement felt necessary as per RFP issued by Indian Army/MoD.

Above mentioned requirements are only indicative in nature, however any other document/information/input required by BHEL for cost estimation and for preparation & submission of techno-commercial bid to IA/ MoD shall have to be provided by the Prospective Collaborator (s).

3.5 Prequalification Requirements (PQR):

The Prospective Collaborator(s) must meet the following qualification requirements as on the date of submission of Eoi **(to be substantiated by suitable documentary evidence)**:

- a) The Prospective Collaborator (s) should have designed, developed, engineered, manufactured, integrated & successfully tested and proven at least 1 (one) no. 155 mm /52 Caliber Mounted Gun system as on the closing date of this Eoi.
(Preference shall be given to the OEM who has supplied at least 1 Nos 155 mm/ 52 Caliber MGS which is operational/ successfully inducted)

AND/OR

The Prospective Collaborator (s) / should have the capability to design, engineer, manufacture and successfully test the Wheeled Platform for military/ defence use suitable for mounting the 155 mm /52 Gun System as on the closing date of this Eoi.

AND

- b) The Prospective Collaborator (s) should have the capability to engineer, design and customize the systems/equipment defined at (a) to meet the parameters defined in the RFP floated by MoD for 155 mm/ 52 MGS for the Indian Army.

3.6 Brief Description of Eoi Process:

The interested Prospective Collaborator (s) shall ensure that their response, along with details requested as per the Annexures of this Eoi, is received by BHEL on or before **August 18 , 2023 (Friday)**. The response(s) shall necessarily be accompanied with details on company background, technical features/ product catalogue, reference list, annual audited financial reports for last 3 (three) years including auditor's report and other enclosures as required under the present Eoi. The Prospective Collaborator (s), on submission of their response(s) can be called for further discussions at a short notice.

The Prospective Collaborator(s) shall also need to furnish a declaration that export to India of the MGS & their technologies from their respective country(ies) is in no way restricted.



Expression of Interest (Eoi) for technology tie-up for 155 mm / 52 Caliber Mounted Gun System (MGS)

The respondent shall submit their offer with all Annexures duly signed. In case any further information is needed, kindly feel free to contact us. In case any amendment/ corrigendum issued to this Eoi, it shall be notified only at www.bhel.com.

3.7 Miscellaneous:

A. Right to accept or reject any or all Applications:

- 1) Notwithstanding anything contained in this Eoi, BHEL reserves the right to accept or reject any Application and to annul the Eoi Process and reject all Applications, at any time without any liability or any obligation for such acceptance, rejection or annulment, and without assigning any reasons therefore. In the event that BHEL rejects or annuls all the Applications, it may, at its discretion, invite all eligible OEMs/Suppliers to submit fresh Applications.
- 2) BHEL reserves the right to disqualify any Applicant during or after completion of Eoi process, if it is found there was a material misrepresentation by any such Applicant or the Applicant fails to provide, within the specified time, supplemental information sought by BHEL.
- 3) BHEL reserves the right to verify all statements, information and documents submitted by the Applicant in response to the Eoi. Any such verification or lack of such verification by BHEL shall not relieve the Applicant of his obligations or liabilities hereunder nor will it affect any rights of BHEL.

B. Governing Laws & Jurisdiction

The Eoi process shall be governed by, and construed in accordance with, the laws of India and the Courts at New Delhi (India) shall have exclusive jurisdiction over all disputes arising under, pursuant to and/ or in connection with the Eoi process.

Annexure-1

Indicative Scope of Technology Transfer

1.	Licensing & transfer of state-of-the-art technology including IPR (if required) relating to (including know-why & know-how, as required), develop, engineer, manufacture, assemble, test, integrate, commission, maintain, operate, repair, overhaul/retrofit, service, troubleshoot and sell Mounted Gun System as per requirement of IA/ MoD.
2.	Transfer of applicable computer programs including logics and source code, if any
3.	Transfer of improvements/modifications/developments/up gradations carried out by the Prospective Collaborator(s) over the duration of the technology transfer for taking care of new market requirements and obsolescence of components used in the system
4.	Assistance in planning & setting up of the facilities by way of expert advice in terms of identifying, sizing & selection of equipment required for manufacturing and assembly, their layout and foundation etc.
5.	Assistance for establishing manufacturing processes, commissioning of the manufacturing facilities, design of special tools and dies, jigs & fixtures etc. by way of deputation of experts for agreed number of man days as and when required by BHEL.
6.	Transfer of Site feedback and troubleshooting information.
7.	Training in the design, manufacture, assembly, quality control / quality assurance, testing, installation, commissioning, maintenance, operation & retrofitting.
8.	Deputation of prospective collaborator's experts to assist BHEL in absorbing the technology for licensed products.
9.	Support through engineering services from prospective collaborator's design office / manufacturing facilities for licensed products.
10.	Transfer of information to enable BHEL to source/procure those items, which the prospective collaborator (s) sources from outside (as they are not manufactured by the prospective collaborator) for use in MGS.
11.	Complete know how and know-why (as required) of MGS as whole and each system independently.
12.	In case of upgrades of in-service equipment/systems/platform, the requisite technology & capability to implement the required upgrades will be provided by the Prospective Collaborator (s).

Signature & Seal:

Authorized Signatory of the Prospective Collaborator

Annexure-2

Prospective Collaborator's response on proposal for Technology tie-up for 155 mm / 52 Mounted Gun System(MGS) Caliber

S No.	Requirement (If required, NDA can be signed to facilitate the Prospective Collaborator to share the details of past supplies made)	Response YES/NO (reference of supporting document)
1.	Whether the Prospective Collaborator (s) is an Original Equipment Manufacturer of Mounted Gun System.	
2.	<p>Whether Prospective Collaborator (s) meets the below PQR specified in this Eoi:</p> <p>a) The Prospective Collaborator (s) should have designed, developed, engineered, manufactured, integrated & successfully tested and proven at least 1 (one) no. 155 mm /52 Caliber Mounted Gun system as on the closing date of this Eoi. (Preference shall be given to the OEM who has supplied at least 1 Nos 155 mm/ 52 Caliber MGS which is operational/ successfully inducted)</p> <p align="center">AND/OR</p> <p>The Prospective Collaborator (s) / should have the capability to design, engineer, manufacture and successfully test the Wheeled Platform for military/ defence use suitable for mounting the 155 mm /52 Gun System as on the closing date of this Eoi.</p> <p align="center">AND</p> <p>b) The Prospective Collaborator (s) should have the capability to engineer, design and customize the systems/equipment defined at (a) to meet the parameters defined in the RFP floated by MoD for 155 mm/ 52 MGS for the Indian Army.</p>	
3.	Whether the Prospective Collaborator (s) has a prior experience of designing, testing & supplying MGS.	
4.	Whether the Prospective Collaborator (s) agrees to transfer design know-how & know-why including the associated IPR technology.	
5.	Whether Prospective Collaborator (s) is willing to participate under the "Buy(Indian-IDDM)" categorization of DAP 2020.	

6.	Whether the Prospective Collaborator (s) owns the IPRs for the technology being proposed for transfer under the Technology Collaboration Agreement (TCA) or have an unencumbered right from the owner of the IPRs to sub-license the technology, if applicable. If yes, whether list of such IPRs is enclosed.	
7.	Whether Prospective Collaborator (s) agrees to support BHEL in integration of their respective product to enable BHEL supply the complete MGS.	
8.	Whether Prospective Collaborator (s) agrees to support BHEL in System integration including with the in service Fire Control Radar (to be provided by Indian Army) and proving of the complete system as per RFP parameters.	
9.	Whether Prospective Collaborator (s) agrees to manufacture/arrange desired unit(s) of MGS for trials on No Cost No Commitment basis.	
10.	Whether the Prospective Collaborator is willing to provide the product support in terms of maintenance, materials and spares for a minimum period of 25 years from the last MGS being supplied under the contract / as required by IA/ MoD.	
11.	Whether the Prospective Collaborator (s) is willing to provide all upgrades and modifications carried out on the equipment during the term of the technical collaboration agreement and/or other agreement.	
12.	Whether the Prospective Collaborator (s) is willing to enter into a long term Supply Agreement for supply of agreed equipment and component as per procurement conditions of IA/ MoD.	
13.	Whether declaration that “export of product and technology (including IPR) for the MGS from Prospective Collaborator’s country to India is in no way restricted” is enclosed.	
14.	Whether Prospective Collaborator (s) agrees to support BHEL during interactions with the IA/ MoD for initial screening, participation in the RFP and subsequent qualification process by way of deputing their experts to India and providing the required information and clarifications as required/sought by IA/ MoD.	
15.	In case of getting shortlisted as a result of this Eoi process whether Prospective Collaborator (s) agrees to provide following support to enable BHEL to prepare and submit a competitive techno-commercial bid to IA/ MoD as per the terms of the RFP (& other requirements as applicable) and also to successfully execute the contract in case of BHEL emerging as qualified bidder:	

	<p>i. To provide costing elements required for preparation of BHEL offer against RFP. Costing elements to cover the details of major materials used in MGS, manufacturing process, facilities including major machines, assembly & special test equipment, special processes and other suitable details on shop layouts etc., any other pertinent detail. The information to include known supplier sources for such facilities/equipment.</p> <p>ii. To provide a price list with long term validity with Price Variation clause for assemblies/ sub-assemblies/ components/ spares/ manufacture's recommended list of spares (MRLS) etc. for items to be sourced from prospective collaborator</p> <p>iii. Any other requirement felt necessary as per RFP issued by Indian Army/MoD.</p>	
16.	Whether information on market share has been enclosed.	
17.	Whether Prospective Collaborator's detailed reference list have been enclosed.	
18.	Whether Prospective Collaborator's annual audited financial reports for last 3 years have been enclosed.	
19.	Whether the MGS offered for technology transfer is the latest/ State-of the-Art being marketed by the Prospective Collaborator (s)	

Signature & Seal:

Authorized Signatory of the Prospective Collaborator

Annexure -3 (Optional)

Questionnaire on various technical specifications & parameters of 155 mm / 52 caliber Mounted Gun System

A. Performance & essential parameters of Mounted Gun System 155MM / 52 caliber

SN	Description	Response with specific details against required parameters
PERFORMANCE PARAMETERS		
1	Gun	
a	Maximum & Minimum Combat Weight (Excluding Crew)	
b	Crew persons, including commander and driver.	
2	Firing Parameters	
a	Maximum Range	
	With HE ERFB (BT) Projectiles	
	With HE ERFB (BB) Projectiles	
	Direct Fire.	
	Day	
	Night	
b	Rates of Fire (With First Round Loaded in Chamber)	
	Burst (Highest Zone)	
	Intense (Highest Zone)	
	Sustained (Highest Zone)	
c	Accuracy & Consistency of Fire: Achieve accuracy and consistency of fire when measured as Probable Error at 80% of maximum range at low angle fire with standard HE ERFB (BT) projectile as below:	
	Indirect Fire.	
	i. Accuracy	
	ii. Consistency	
	Direct Fire.	
d	Time Into / Out of Action.	
3	Mobility Parameters.	
a	Power to Weight Ratio.	
b	Average Speed (In Plains).	
	i. Black top road	
	ii. Desert Track	
c	Cruising Range (On Road) on full fuel tank in plains (Black top road).	
d	Gradient with full payload	
e	Side Slope Stability with full Payload	
f	Ground Clearance	
g	Trench Crossing	
h	Water Crossing without Preparation.	

SN	Description	Response with specific details against required parameters
i	Turning Circle Diameter, as measured from the central axis of the MGS.	
4	Sighting System.	
a	Indirect Fire Sight : Inertial Navigation System based sight based on 6400 mils with suitable means of aligning the MGS barrel to the desired bearing and elevation. The indirect fire sight should have compatibility with Gun Laying Drive capable of aligning the MGS barrel at the desired bearing and elevation automatically and with manual override.	
b	Day and Night Thermal Imaging (TI) Sight	
	i. A day and night TI sight with eye safe Laser Range Finder capable of recognizing and engaging a target measuring 3 m x 3 m	
	ii. Range Accuracy.	
Features & Capability		
5	Ammunition loading shall be automatic from lifting of projectile to loading & ramping in chamber.	
6	Muzzle Velocity Radar (MVR).	
	Compatible and integrated MVR mountable on the MGS. The FCS should be capable of computing adopted MV.	
7	Ammunition Carriage	
	Stow and carry at least 24 x 155MM High Explosive Base Bleed projectiles along with its authorized quantity of primers, fuzes and at least 144 Bi-Modular Charge System (BMCS).	
8	Operating Temperature Range	
	The MGS should be capable of operating in plains, desert and HAA upto 5000 meters with minimum temperature between minus 15°C and maximum temperature plus 45°C.	
9	FCS system with integrated Ballistic computer system and INS with Satellite based navigation having alignment timing less than equal to 8 mins and accuracy of fixation & Orientation as +/-25m upto 10km from point of initiation and +/- 1mils or better (in 6400mils configuration) respectively.	

B. Miscellaneous Questionnaire

S No.	Specification / Parameters	Response with specific details against required parameters
1	Operational Parameters	
	a) Gun	
	i. What is the length, width and height of the gun in Meters in travel position ?	
	ii. What is the length of barrel in meters?	
	iii. What is the maximum altitude above MSL that the gun can be employed with and without special preparation/ modification?	
	iv. <u>Time Into / Out of Action</u> . What are the time limits for the gun to come into and out of action during Day and during Night?	
	v. <u>Safety Arrangements</u> . What are the safety arrangements on the equipment to ensure the following:- (aa)The gun does not fire till breech block is closed. (ab)The gun does not fire till fully run out.	
	vi. What is the minimum Combat Weight (Excluding Crew) of the gun in Kg achievable?	
	vii. What is the service life of Gun (in years) and service life of the barrel in terms of Equivalent Full Charge (EFC)?	
	viii. How many personnel are required as crew (including the commander and driver) to operate the gun?	
	ix. Is the gun system able to fire 155 mm ammunition all in service presently with Indian army?	
	x. What are the traverse limits at all angles of elevation? (Mention as ____ degrees Right and ____ degrees Left for ____ to ____ angle of elevation)	
	b) Fire Control System (FCS)	
	i. Is the FCS capable of receiving the gun data from the Command Post in digital as well as manual feed by the gun crew?	
	ii. Is the FCS capable of laying the gun automatically, after input of command from the crew, at the desired bearing and elevation?	
	iii. Is the software used in FCS is 100%	

		indigenous?	
	c)	Accuracy and Consistency in Low Angle at 80 Per Cent of Maximum Range for Standard HE Ammunition and HE Base Bleed Ammunition in Low Angle.	
		What is the consistency of the gun in terms of the following:- i. Range. ii. Line.	
	d)	<u>Recoil System</u> . What is the type of recoil system in the Gun ?	
	e)	<u>Obturation System</u> . What type of obturation system is in use with the Gun?	
2)		Mobility Parameters	
	a)	What fuel is used by the gun ?	
	b)	What is the maximum speed of the vehicle/gun on Blacktop roads and on beaten desert tracks?	
	c)	Can the gun be carried in the service aircraft like IL 76, C17 & C130 ?	
	d)	What is the maximum gradient negotiable by the gun?	
	e)	What are the emission norms to which the gun is compliant?	
	f)	What is the depth of water body which can be crossed / negotiated by the gun without any additional preparation or equipment?	
	g)	Is central tyre inflation and pressure regulation present in the gun?	
	h)	What is the maximum power output in KW and BHP? Specify the engine RPM at which the power output is achieved?	
	i)	Is the engine power output and Torque generated adequate to haul the vehicle loaded with on board ammunition and gun to move over a gradient of 15°? If not, what is the engine power output and Torque recommended by you to meet this requirement?	
	j)	Whether the gun sys is based on 4x4 light vehicle or 6x6 / 8x8 high mobility truck configuration?	
	k)	Can the gun negotiate without additional preparation on the assault bridges in service in Indian Army ?	
	l)	Brakes : Does the gun have Anti Lock Brake System ?	
		What are the parameters for overhaul of the vehicle engine?	

		Is the vehicle provided with auto transmission?	
		What all parameters are visible on the display panel to the Driver / Co-driver?	
	m)	Also confirm the following for strategic mobility i. Compatibility with existing MBWTs/ BOM Wagon on Broad Gauge railway lines with Over Dimension Clearance (ODC). ii. Transportable by in-service C-17 aircraft without any modifications.	
	n)	What is the minimum Turning Circle Diameter, as measured from the central axis of the MGS achievable?	
3)	Ammunition Loading.		
	a)	What is the Automation feature for projectile handling should be provided i.e for lifting projectile placed on MGS vehicle, placing the same on loading tray and able to automatically load and ram the projectile in the chamber.? Also confirms whether it is possible to load the gun manually?	
	b)	Confirms whether the Shell Extractor Mechanism is provided for extraction of unfired loaded projectile?	
4)	Winch		
	a)	What is the length of the winch rope outside the rear guard of the vehicle?	
	b)	What is the winch capacity to recover the vehicles of same class and self-recovery?	
	c)	Whether the control of the winch assembly are accessible and within reach of the operator to carry out all operations?	
5)	Towing Arrangements		
	a)	Is the towing arrangement suitable for the same weight class with suitable D shackles and tow pins at the front and rear of the MGS with double lock?	
6)	Sighting System.		
	a)	Does the equipment have an Backup Optical Sights for indirect and direct fire during Day and Night ?	
7)	Backup		
	a)	Does the gun have integral back-up arrangements for enabling automatic functions including laying, loading, firing as well as to bring the MGS into and out of action? If yes, then	

		what will be the duration (in hours) shall perform till bringing MGS brining out of action.	
8)	Manual Backup		
	a)	Does the gun have manual backup for coming into action/ out of action, laying loading and firing of the gun system?	
TECHNICAL PARAMETERS			
9)	Fire Control System.		
	a)	Is the Ballistic Computer System integrated with the FCS?	
	b)	Is the system capable of computing data for target engagement for in-service 155mm ammunition?	
	c)	Is the equipment equipped with an integrated MVR ?	
	d)	Does the gun have provision to manually and automatically update the acquired MV for charge temperature and projectile weight?	
	e)	Does the gun have compatibility with Defence Series Maps?	
	f)	Does the gun have the compatibility with Artillery Combat, Command and control System (ACCCS)- Project SHAKTI (Selected vendors after CNC to provide Communication Interface Unit (CIU), Trajectory Computation Module (TCM) and integrate digital communication protocol)?	
	g)	Is the FCS capable of receiving the gun data from the Command Post in digital as well as manual feed by the gun crew?	
	h)	Is the FCS capable of laying the gun automatically, after input of command from the crew, at the desired bearing and elevation?	
	i)	Does the FCS feature to facilitate the autonomous gun mode?	
	Inertial Navigation System (INS) with Satellite Based Navigation		
	a)	What is the INS Alignment Timing in minutes?	
	b)	What is the Accuracy of Fixation (without GPS) in mtr from point of initiation?	
	c)	What is the Accuracy of Orientation (in 6400 mils configuration)?	
	d)	Confirm the coordinates for In-service Indian Military Grid System (horizontal and vertical, DSM (Digital surface model) and WGS84 (World Geodetic System)?	
	e)	Is the satellite navigation system capable of tracking the existing GPS, GLONASS and GNSS services?	

	f)	Is the satellite navigation system capable of tracking the IRNSS services, by default?	
	Software		
	a)	Can we restore the FCS Software in field? Does the FCS software has the provision for future upgrades?	
10)	Communication Equipment		
	a)	What are the arrangements for communication from Command Post to Each Gun and Troop Leader?	
	b)	What are the arrangements for Detachment Intra Communication?	
11)	Safety Arrangements		
	a)	How can we ensure that guns are designed to only fire when the breech is fully closed?	
	b)	How can we ensure that guns are designed to only fire when they have fully run out?	
	c)	Does the gun have a facility to securely install the firing mechanism?	
	d)	Do we ensure that once breech is closed, it should not open unless the gun has fired or without physical action by operator?	
	e)	Do we ensure that firing is stopped when the gun is beyond the safe transit/elevation limit?	
	f)	Do we ensure that firing is stopped when the gun is beyond the safe transit/elevation limit?	
	g)	Are safety lights are provided in front and at the rear of the gun system?	
	h)	Is over voltage and overload protection including surge protection are provided?	
	i)	Is prevention of double loading of Shell and Charges provided?	
	j)	Whether the system has been provided on the MGS to indicate the following: - i. Readiness to fire. ii. Level of oil and air pressure in the recoil system. iii. Chamber loaded. iv. (iv) High barrel temperature conditions to prevent cook off.	
	k)	Has the suitable locking arrangement provide for locking azimuth and elevation axes?	
	l)	How does the operator console not allow the entry of commands for moving traversing and elevation mechanism of the hydraulic/	

		pneumatic/ electric drive to enter within the arc containing the vehicle cabin, when the gun is at an elevation less than that considered safe to fire over the cabin?	
12)	Vehicle		
	a)	Whether the Diesel Engine meets the latest CMVR norms with permissible exemption?	
	b)	What is the expected engine life?	
	c)	Is the vehicle Right Hand Drive with power steering? Is the vehicle provided with auto transmission?	
	d)	Is the driver cabin Small Arm protected (level 1 of STANAG 4569)	
	e)	What is the seating capacity in driver cabin (including commander & driver)?	
	f)	Are seat belts available on all available seats (as per CMVR) in driver cabin?	
	g)	Are there two berth (bunk bed) type seats, behind the driver and co-driver seats inside the cabin?	
	h)	Is there an Observation hatch atop driver cabin?	
	i)	Whether a safety shield of minimum three mm has been provided, which should be used to cover the wind shield and windows of the cabin during firing?	
	j)	Is the vehicle provided with Brackets for carriage of first aid kit and personal weapons of the crew members?	
	Wheels and Tyres.		
	a)	Are the wheels have BIS complaint sand cum highway tyres?	
	b)	Is Bead lock provided to prevent the tyre from sliding of the rim in the event of a puncture?	
	c)	Has the central inflation facility been provided for the wheels with suitable arrangement to inflate/ deflate tyres from the driver's cabin? Is the tyres air pressures displayed in driver cabin?	
	d)	Do the Tyres have the facility to fit anti-skid chains?	
	Vehicle Brakes.		
	a)	Is Brake system provided to hold the vehicle on all gradients minimum up to 20 degrees with full pay load on hard surface?	
	b)	Has it been ensured that the Hand Brake should hold the vehicle on all gradient's minimum up to 20 degrees with full pay load, on hard surface?	

	c)	Is the vehicle provided with Hill Hold Assist feature to hold the vehicle in an uphill/ downhill slope?	
	d)	Is the display panel provided for the driver to observe while driving the vehicle? Also it shall be ensured that following indicators (audio or visual) be incorporated in the display panel in the driver's cabin:	
	i.	Engine oil pressure dropping below safe limits.	
	ii.	Alternator not charging.	
	iii.	Engine temp exceeding safe limits.	
	iv.	Warning device to indicate winch rope completely laid out.	
	v.	Differential lock/ Axle locks engaged.	
	vi.	Ignition key in the socket, once the engine has been switched off.	
	vii.	Fuel Gauge, engine RPM and reverse parking.	
	Lighting - In addition to standard lights required as per CMVR light fitting, following lights should be provided		
	a)	Is the driver compartment provided with an interior light and map reading lamp?	
	b)	Are Fog lights provided?	
	c)	Is there a light provided in engine compartment? What is the arrangement is provided for shaded lighting in the rear body to facilitate loading and unloading?	
	d)	Is the Vehicle stabilization system provided for the MGS to provide a stable platform during firing?	
	Miscellaneous		
	a)	Does the vehicle have a Rear-View Camera and Warning System to ease deployment of the gun?	
	b)	Is the vehicle provided with a buzzer alarm between the driver's cabin and crew sitting in the rear of the vehicle?	
Maintainability and Ergonomics parameters			
13)	Modularity		
	a)	Is the construction in Modular to facilitate repairs in field through replacement of modules?	
14)	Reverse Polarity		
	a)	Is the Protection/ provision provided to prevent reverse polarity fitment for all Printed Circuit Boards/ Cards/ Cables/ Batteries ?	

15)	EMI/ EMC Compatibility.	
	a)	Is the Mounted Gun System have the EMI/ EMC compliant as per Military Standards 461E/ F or higher version?
16)	Built in Test Equipment (BITE) Facility	
	a)	Can detect and locate failures that occur on the major system of the weapon systems (e.g, FCS, Recoil System, loading system, laying system)? Is the Audio/ Visual alarm provided to indicate test failure?
	b)	Is there test facility for online and offline test?
17)	Firing Parameters: What is the minimum range achievable by the gun in high angle with standard HE ammunition?	
18)	Ease of Reading and Viewing.	
	Are all displays readable/viewable to the crew member relating to functional status without additional arrangements during both day and night?	
19)	Environment Control Unit (ECU)	
	a)	Is the driver cabin provided with environmental control arrangement (cooling as well as Heating arrangement) which should be capable of maintaining an inside cabin temperature of 25 ± 3 °C. And for ambient temperature beyond 40 °C minimum drop of 15 °C and for ambient temperature below 10 °C minimum temperature increasing of 15 °C should be achieved?
20)	Miscellaneous Details	
	a)	Protection over vehicle body from rain & dust through tarpaulin cover is provided and what is provision of fire safety onboard?
	b)	Drinking Water storage capacity and total stowage provisions for fuel, vehicle tools, spare wheel, personal kits, camouflage net, First Aid kits and personal weapons etc?
	c)	Does the cabin cater for environment control?
	d)	Power Source. What is the source of power for automatic functions? What are the details of Auxiliary Power Unit (APU).
	e)	Power Backup Arrangements. Does the gun have alternate back-up arrangements for enabling automatic functions including laying as well as to bring the MGS into and out of action?
	f)	Cold startup. What are the cold starting arrangements provided for ignition of engine upto -20°C and altitude upto 5500 meters?

g)	<u>Camouflage.</u> What are the options for camouflage arrangement that can be provided and also facilitate shoot & scoot capability of the system.	
h)	<u>Military Materials.</u> Does the military material used in the equipment have indigenous source of supply?	
i)	<u>Mounting Bracket for Light Machine Gun</u> Does have provision in-service Light Machine Gun for self defense on/ over the cabin with arrangements to carry 800 rounds of ammunition in magazine box?	
j)	<u>Maintenance Philosophy.</u> What would be the Maintenance philosophy for repair and maintenance of the gun and vehicle? Can it be aligned with the system of unit and Field level repairs prevalent in the Defence Services?	
k)	<u>Product Support.</u> i. What kind of 'Product Support' will be ensured including warranty & AMC proposed? What will be 'Time Period'? ii. Does the company have major repair and overhaul facility for major assemblies and component level repair? iii. Can ESP (Engineering Support Package) comprising of MRLS (Manufacture Recommended List of Spares), SMT (Special Maintenance Tools) / STE (Special Test Equipment), Technical Manual / Documents, Training Material including Sectionised Models, Training Charts and CBT (Computer Based Test) packages be provided?	
l)	<u>Warning Arrangements.</u> What warning arrangements are incorporated to ensure safe operation and maintenance of the gun?	
m)	<u>Onboard Test Equipment.</u> Give out the details of following:- i. On line test facilities. ii. Off line test facilities. iii. Hardware test facilities.	
n)	<u>Environmental Performance.</u> i. What is the temperature range in which the gun system will function efficiently? ii. Does the gun comply with JSS 55555 standards?	
o)	<u>Standardization.</u> i. Are the assemblies, sub-assemblies,	

	<p>components, parts and materials used in the equipment conforms to relevant MILSTD(S) and in the absence of MILSTD(S), other internationally accepted standards?</p> <p>ii. Are the assemblies, sub-assemblies, components, parts and materials used in the equipment conform to relevant MIL STD (S)/ JSS-55555 and in the absence of MIL STD (S)/ JSS-55555/ CQAL specifications, other internationally accepted standards whichever is applicable? For Opto-Electronic and Optical sighting instrument the test be governed under JSS-5855-11-219 (Rev-1).</p>	
p)	<p><u>Status of Development / Production</u></p> <p>i. What is the present status of development of the gun system?</p> <p>ii. Please specify timelines for fielding the product for evaluation.</p> <p>iii. What is the infrastructure available to produce the MGS in India?</p> <p>iv. What is / will be the annual production capability of your firm?</p> <p>v. Number of EUTs that can be provided for trials. One EUT of selected vendors will be retained till commencement of production.</p>	
q)	<p><u>Indicative Cost.</u> Likely cost of production of one MGS in broad percentage wise breakdown to facilitate formulation of PVC formula as given below:-</p> <p>i. Fixed Percentage.</p> <p>ii. <u>Material Percentage.</u> Only two to three major materials to be mentioned.</p> <p>iii. Labour Percentage.</p>	
r)	<p><u>Details of Joint Venture (JV) Partners.</u> Please specify details of foreign firm(s) as JV partner(s). (if any). How much time will the startup/JV take to start production?</p>	
s)	<p>Whether it is indigenous design and development? If No, whether the vendor has IPR for the eqpt? Maximum IC Content that can be confirmed by the vendor?</p>	
t)	<p>Is this eqpt in service with any other country? If yes, furnish details of quantity supplied to the country and year of supply? In which country and Def/ Para Mil forces has the eqpt in service and since when?</p>	
u)	<p>Will you be able to offer sectionised /cut models, 3D models, CDs for training whether</p>	

		simulators for the equipment are available and will be provided?	
	v)	Any other relevant info in terms of specifications/ terms of ref, the OEM/ vendor would like to share.	
	w)	What fire safety arrangements are provided with the system?	
	x)	Whether the driver cabin & crew cabin are capable of operating in NBC environment? What are the specifications of the anti-NBC system?	
	y)	Max feasible preservation period, if reqd? effect of preservation on warranty.	
	z)	What is the feed system of ammunition?	
	aa)	Does the storage facility for ready to fire ammunition exist on the Gun? If so, how many rounds can be stored on the gun?	
	ab)	How many personnel are required for loading of ammunition during the operation of the gun?	
	ac)	Does the gun have any associated equipment? If so, give brief description of the associated equipment with purpose.	
	ad)	Are there any special features that will ensure effective operation in mountainous terrains?	
	ae)	How is the gun powered and does it have on board power supply? Battery capacity permits what duration for operation of gun? Can the gun operate from commercial mains/generator of 220V 50Hz AC? Are the batteries rechargeable while system is in operation?	

Signature & Seal:
Authorized Signatory of the Prospective Collaborator