BHARAT HEAVY ELECTRICALS LIMITED
(A Government of India Undertaking)
DELHI - 110049

Notice for Inviting

Expression of Interest for Selection of Technology Partner for KAVACH (The Indian Railway Automatic Train Protection System)

EoI No: BHEL/AA/TL/0710

Date of Issue: March 13, 2023

Last date for submission of EoI response: April 03, 2023

Subject: Selection of Technology Partner for KAVACH (The Indian Railway Automatic Train Protection System)

1) Introduction

This Expression of Interest (EoI) seeks interest from Company(s)/Original Equipment Manufacturers (OEMs) who are willing to partner with BHEL on long term basis for development, certification/approval of KAVACH system as per system specification no. **RDSO/SPN/196/2020 Version 4.0 d3** issued in June-2022 by Research Design and Standards Organisation (RDSO), Indian Railway. (https://rdso.indianrailways.gov.in/uploads/File/System%20Requirement%20specification%20of%20KAVACH.pdf)

Such Company(s)/OEMs should be able to assist BHEL in development of KAVACH system (including hardware, Software and its associated sub-system including Loco TCAS and Station TCAS etc.), approval from Research Design and Standards Organisation (RDSO), SIL-4 certification of hardware by authorized agency(ies), participation in Signalling & Telecommunication infrastructure development tenders of Indian Railways, erection, commissioning, maintenance and troubleshooting of the commercial orders on long term basis.

2) About Bharat Heavy Electrical Ltd (BHEL)

BHEL is a leading state-owned company, wherein Government of India is holding 63.17% of its equity. BHEL is an integrated power plant equipment manufacturer and India's largest engineering and manufacturing enterprise of its kind, catering to the core infrastructure sectors of Indian economy viz. energy, transportation, Oil & Gas, heavy engineering industry, renewable & non-conventional energy and defence. 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 2021-22 was around USD $2.7 Billion (Rs 20153 Cr). Highly skilled and committed manpower of approx. 30000 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 includes 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); 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 Company Ltd., Korea (for SCR Catalysts); HLB Power Company 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) BHEL presence in Railway Transportation Business

BHEL is into the manufacturing of complete electric locomotives, diesel electric locomotives and electrical assemblies/components including traction motors, traction transformers, power & auxiliary converters and controls, gear wheels etc. Among electrical propulsion equipment, BHEL manufactures and supplies traction motors, traction transformers, power converters (IGBT) & controls, auxiliary converters (IGBT) and vehicle control units for electric locomotives, diesel electric locomotives and EMUs.

Our Manufacturing range includes conventional DC drive, IGBT based 3-phase drive equipment for various ratings for AC Locomotives, Air conditioned and Non-air-conditioned EMUs and MEMUs. BHEL has also been in the forefront of providing maintenance and spares/replacement support to Indian Railways for their locomotive fleet. BHEL has full-fledged service department located at major centers in the country.

4) Expected/Desired Technical Capabilities of prospective partner

4.1 The Prospective Partner shall possess design of Train Collision Avoidance System/European Train Control System Level -1 (minimum); the product should either have got approved or should be under approval stage by RDSO/Indian Railways/European Rail Union/European Rail Traffic Management System.

OR

4.2 The prospective technology partner should have designed and supplied Loco TCAS and Station TCAS approved by RDSO to Indian Railway

OR

4.3 The Prospective partner should have designed and supplied at least one product from each set of 4.3.1 & 4.3.2 for any RDSO/Indian Railway projects/Foreign Railway Projects/Firms listed here below:

4.3.1 Signalling Equipment Set-1:

i. Automatic Train Protection System
ii. Communication based Train control systems (CBTC)
iii. Automatic Train Operation System (ATO)
iv. Wheel impact load detector system (WILD)
v. Distributed power wireless control systems (DPWCS)
vi. Advanced collision avoidance systems namely Anti Collision Device (ACD)/Train Protection and Warning systems (TPWS)/Train Automatic Braking system
vii. Analog/Digital Axle Counters (Single/ Multi-Section)
viii. Electronics Interlocking (EI)
ix. Automatic Telemetry (EOTT)
x. End-Of-Train Telemetry Systems (EOTT)

4.3.2 Signalling Equipment Set-2:

i. Cyber Signalling system
ii. Train Control and Management Systems (TCMS)
iii. Remote monitoring systems (RMS)
iv. Train Network Management Systems
v. Train Loco Simulators
vi. Track & Station Simulators
vii. Train Human Machine Interface Systems
viii. Radio Remote control systems
ix. Rail Automation controllers
x. Wireless multi-unit coupler system
xi. Brake Interface Unit (BIU)
xii. Incremental Train Control System (ITCS)

The Prospective Technology Partner should submit Proof of approval / Purchase order (un-priced) from Indian Railways/RDSO/ETCS/ERTMS/ERU/Other firms for products mentioned in Clause 4.1, 4.2, 4.3 above.

5) EoI process

Interested company(ies)/OEM(s) having proven technology and experience in the signalling equipment listed in Clause 4 are requested to submit response along with following documents (in hard/soft copy) on or before **April 03, 2023 (Monday):**

i. Company background
ii. Technical features/data sheet
iii. Product catalogue
iv. Existing business in the field of rail transportation sector- Propulsion Systems and its services
v. digitalisation business using the technology of prospective Technology partner
vi. Reference list and details of existing business in the field of Rail Signalling and Telecom/Propulsion Systems/services/ Business of prospective Technology partner to be provided along with list of customers where the technology is under use and from how many years.
vii. latest three years annual audited financial statements including auditor's report.

Based on the responses received and discussions with respondents, separate **Request for Partnership (RfP)** shall be issued by BHEL with scope of the technology partnership.

In case any amendment/corrigendum issued to this EoI, it shall be notified only at www.bhel.com

6) Contact Details

The respondent shall submit signed copy of the EoI along with Annexures, supporting documents specified above in this EoI to the following official:

Sr. Deputy General Manager
Corporate Technology Management
Bharat Heavy Electricals Limited
BHEL House, Siri Fort
New Delhi – 110049, India
Phone: +91 11 66337458 / 7213
Mobile: +91 9441176267 / +91 9818103430
Email: techeoi@bhel.in

7) Miscellaneous

7.1 Right to accept or reject any or all Applications

7.1.1 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.

7.1.2 BHEL reserves the right to reject 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.

7.1.3 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.

7.2 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

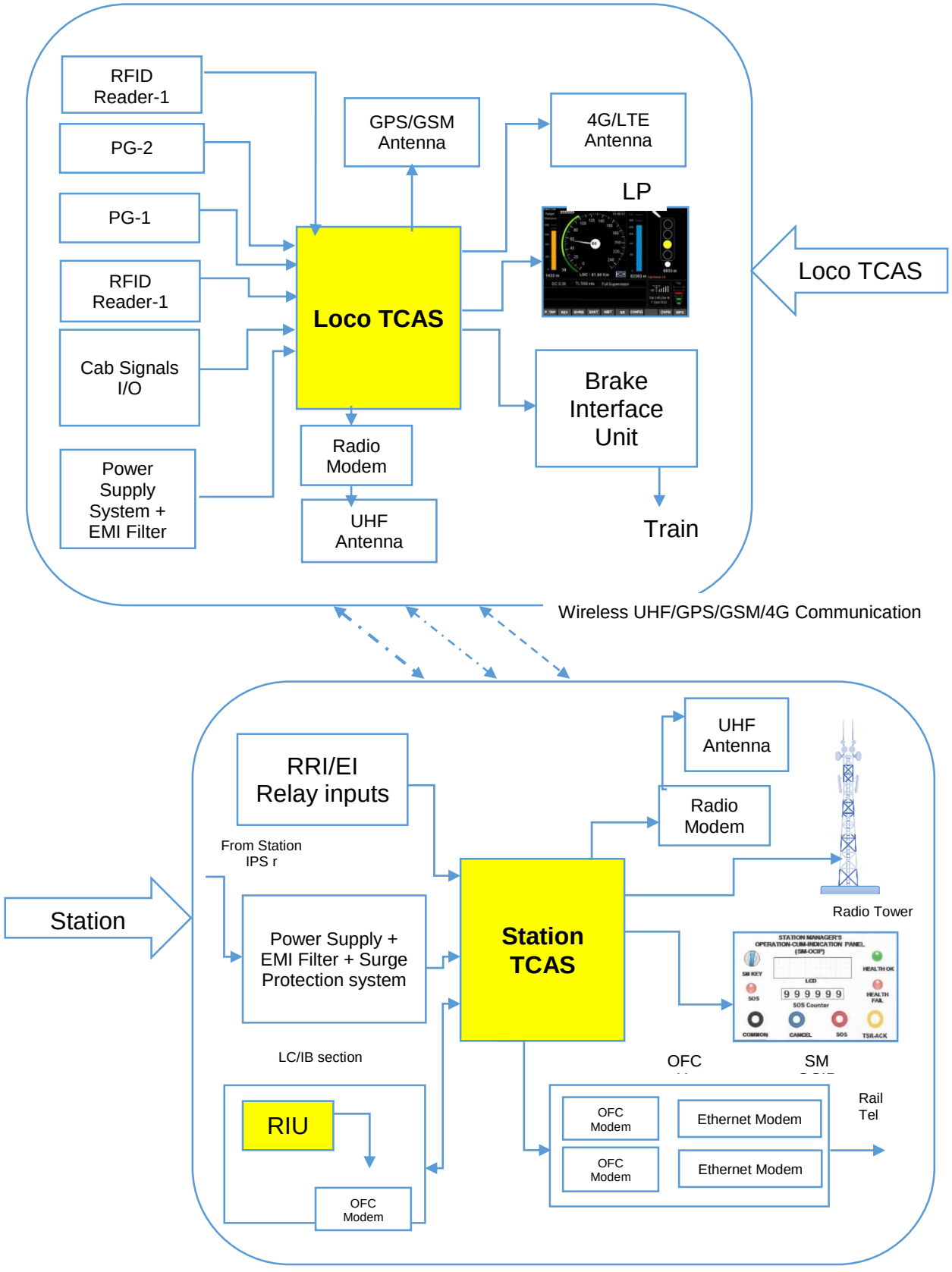
S No	Description of Work	Remarks
1	Design and Development of KAVACH system	Development of KAVACH system (including hardware, Software and its associated sub-system including Loco TCAS and Station TCAS etc.), approval from Research Design and Standards Organisation (RDSO), SIL-4 certification of hardware by authorized agency(ies), participation in Signalling & Telecommunication infrastructure development tenders of Indian Railways, erection, commissioning, maintenance and troubleshooting of the commercial orders on long term basis.
2	Transfer of technological know-how and know-why	• Design calculations • Design documents • Bill of Materials • Hardware Architecture • Software architecture • Hardware schemes • Gerber files • Hardware life cycle analysis • Software lifecycle analysis • Software source code • Firmware • Application codes • Braking algorithms • Communication codes • AES Encryption codes • Support drivers for device functionality • Software tools for writing application codes and Firmware codes. • Test Protocols • RAMS Calculations • SIL -4 certificates • RAMS Submissions • Loco TCAS and Station TCAS integration procedures • Station TCAS and Remote Interface Unit (RIU) integration procedures • Station TCAS and Radio Tower, Station TCAS to another Station TCAS communication procedures • Loco TCAS to another Loco TCAS integration procedures. • SIL-4 certification procedure for overall process • SIL-4 certification procedure for overall product • RFID Communication codes • RS 485, RS 232, USB, CAN, OFC and Ethernet Communication codes

S No	Description of Work	Remarks
		• Sub-Systems datasheets and working procedures, testing procedures • Any other relevant information useful for erection, commissioning and troubleshooting of KAVACH is to be submitted.
3	Training and Troubleshooting (60 Man-Days, 8 Hours/Day, Distributed timelines as per BHEL-Vendor acceptance)	Includes support in the form of training BHEL employees for the following modules of TCAS • TCAS SIL-4 Architectures • TCAS Hardware Scheme preparation, changes and troubleshooting • TCAS Software Code preparation & Troubleshooting • Algorithm implementation for TCAS Safety cases • TCAS Firmware • TCAS Logics • TCAS – RAMS application • TCAS Firmware updating procedure • TCAS Source code updating procedure
4	Functional Testing and approvals from RDSO/Indian Railways	• Support is required for RDSO approval of the system as per the Standards listed below: • TCAS modes and transition • Variation of voltage and interruption of supply as per IEC 60571, 1998. • Supply over voltages and surge test as per IEC 60571, 1998. • Transient Burst and Susceptibility Test as per IEC 60571, 1998. • Radio interference test as per IEC 60571, 1998. • Insulation test as per IEC 60571, 1998. • Applied High voltage tests • Card level/module level tests • Card-level functional checks on each type of PCB modules • Card-level functional tests on each type of PCB modules • Communication peripherals testing • System level diagnostic & functional tests • Environmental tests as specified in the document RDSO/SPN/196/2020 Ver 4.0 d3 • Routine tests as specified in the document RDSO/SPN/2020 Ver 4.0 d3 • Acceptance tests as specified in the document RDSO/SPN/2020 Ver 4.0 d3 • Type tests as specified in the document RDSO/SPN/2020 Ver 4.0 d3

S No	Description of Work	Remarks
		• Integration tests as specified in the document RDSO/SPN/2020 Ver 4.0 d3 • Interoperability tests specified in the document RDSO/SPN/2020 Ver 4.0 d3 or RDSO Purchase order
6	Independent Safety Agency (ISA – SIL 4) certification	Technology partner shall support BHEL for erection and commissioning of TCAS system and subsequently SIL-4 certification. Following list of documents may need to be prepared and submitted for **ISA-RDSO** stage-wise approvals: • Component verification reports • System requirement specifications • System assessment reports • System acceptance reports • Test witness reports for generic application and field application • Process and Product reports • Report on Safety Management in TCAS • Reliability calculations • Risk Analysis • FMECA and FTA reports • Maintainability and availability calculations • Failure rates, MTBF and MTTF calculations • RBD and Voter system reports • RAMS life-cycle reports • First site specific application case reports
7	After-Sales support	• BOM changes • Schematics and revision • Source code and updates • Firmware and updates • Reliability improvements
8	Software & Hardware	• Software for running TCAS should comprise Algorithm, Source code, Firmware and device drivers that can be used by BHEL in various TCAS projects without any limitations. • Hardware should comprise schemes of all control cards with information and detailed datasheets of all latest Chipsets that can be supported by OEM for the next 10-15 Years. • Software & Hardware should be as per relevant CENELAC standards (EN 50126, EN 50128, EN 50129 and EN 50121) compliant with SIL-2/SIL-3/SIL-4 specification and certified by Independent Safety Assessor (ISA) approved by RDSO.

S No	Description of Work	Remarks
9	Intellectual Property Rights	• IP Rights of TCAS products developed with help of technology obtained from Technology partner shall remain with BHEL. • Technology partner shall transfer IP rights already obtained on TCAS technology to BHEL.
10.	Supply, erection and commissioning for 2 No's of prototype for KAVACH	• Separate purchase order for supply, erection and commissioning of Two (02) sets of prototype of KAVACH system may be placed by BHEL's Electronic Division, Bengaluru.

Indicative Architecture Diagrams of KAVACH system



Note: RIU: Remote interface unit, RRI – Route Relay Interlocking, SM OCIP: Station Master Occupancy cum indication panel, OFC –Optical Fiber cable, EI – Electronic Interlocking, IPS – Independent Power supply, UHF – Ultra High Frequency, LTE: Long Term Evolution, PG – Pulse Generator

Annexure -2

Prospective Partner's Experience in the field of Signalling Systems for Railways

Sl. No.	Requirement	Remarks
(a)	Whether the Prospective Partner is an OEM/supplier of complete KAVACH system approved/under approval by RDSO	
(b)	Whether Prospective Partner is an OEM / supplier of Signalling equipment listed in Clause 4.3	
(c)	Whether the Prospective Partner has executed at least one single work contract of design, supply, installation, testing & commissioning of Signaling & Train-Control system/KAVACH during last 5 years.	
(d)	Whether the Prospective Partner is an OEM/supplier of LOCO TCAS system approved/under approval by RDSO	
(e)	Whether the Prospective Partner is an OEM/supplier of Station TCAS system approved/under approval by RDSO	
(f)	Whether the Prospective Partner is an OEM/supplier of SM-OCIP approved/under approval by RDSO	
(g)	Whether the Prospective Partner is an OEM/supplier of RFID Reader approved/under approval by RDSO	
(h)	Whether the Prospective Partner is an OEM/supplier of Brake Interface Unit approved/under approval by RDSO	
(i)	Whether the Prospective Partner is an OEM/supplier of Radio Tower approved/under approval by RDSO	
(j)	Whether the Prospective Partner is an OEM/supplier of RFID Tags approved/under approval by RDSO	
(k)	Whether the Prospective Partner is an ETCS- Level 1 vendor approved by ERTMS/ETCS/EU	
(l)	Whether the Prospective Partner confirms its willingness to facilitate BHEL in establishing required manufacturing/assembly , integration and test facilities for KAVACH Systems for Railways	
(m)	Whether the Prospective Partner has been blacklisted / banned business dealings for Ministry of Railways or any Government Department of India.	
(n)	Whether details of company background, product catalogues have been enclosed.	
(o)	Whether the detailed reference list has been enclosed.	

Sl. No.	Requirement	Remarks
(p)	Whether copy of the Prospective Partner annual audited financial reports for last 5 years has been enclosed.	
(q)	Whether a summary of experience & references have been enclosed.	
(r)	Whether the Prospective Partner owns the IPRs for the technology being proposed) or have unencumbered right from the owner of the IPRs to sub-license the technology, if applicable. If yes, list of such IPRs to be enclosed.	
(s)	Whether the Prospective Partner confirmed the Transfer of essential technology to BHEL to enable BHEL to design, engineer, manufacture, assemble, quality control, test, supply, install, commission, repair, service and retrofit state of the art KAVACH Systems for Railway.	

(SIGNATURE)

Annexure -3

Reference List: The Prospective Collaborator shall furnish a summary of their product reference as detailed below for major supplies in last 5 years.

Sr. No.	Year of Supply	Name of Customer	Description of System/sub-system supplied	Remarks
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

(SIGNATURE)