



MEMORANDUM OF UNDERSTANDING

BETWEEN

BEML LIMITED,
BANGALORE

&

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR
Kharagpur

FOR

JOINT WORKING & DEVELOPMENT OF TECHNOLOGIES
RELATED TO RAIL & METRO ROLLING STOCK

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Memorandum of Understanding

This Memorandum of Understanding signed on the 19th day of June, 2015

Between

BEML LIMITED, a Central Public Sector Undertaking and a Government Company within the meaning of Section 617 of the Companies Act, 1956, under the administrative control of the Ministry of Defence, Department of Defence Production, Government of India, having its Corporate Office at BEML Soudha, 23/1, 4th Main Road, Sampangirama Nagar, Bengaluru 560 027 hereinafter referred to as BEML on the First Part

And

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR, incorporated under the Institutes of Technology Act, 1961 (Act 59 of 1961) as amended by the Institutes of Technology (Amendment) Act 1963 (Act 29 of 1963) hereinafter referred to as IIT KHARAGPUR on the Second Part.

Hereinafter BEML and IIT KHARAGPUR individually be called as "Party" and collectively called as "Parties".

WHEREAS BEML Limited is a leading organization engaged in manufacture of Railway equipment, Defence products and Mining and construction equipment at its manufacturing units at Bengaluru, KGF, Mysore and Palakkad.

Whereas BEML Limited plays a pivotal role and serves India's core areas like - Defence, Rail, Power, Mining and Infrastructure sectors. The company operates under three major Business verticals - viz. Mining & Construction, Defence and Rail & Metro. The company has a dedicated R&D infrastructure and team in line with consistent policy of the company to meet the technological demands through in-house R&D and strategic technical tie-ups with global players. BEML has been the key player in design, development and supply of Rail coaches, maintenance equipment for Indian Railways since its inception and has emerged as a premier supplier of state-of-the-art metro cars for DMRC, BMRCL and Jaipur Metro Corporations.

Whereas BEML intends to foray into medium speed / high speed rail car projects and desires to be in the forefront of the emerging areas, with indigenously developed technologies. This would help in achieving self-sufficiency and reduce the dependency on the foreign players.

Whereas Indian Institute of Technology Kharagpur is a premier educational and research institution of the country. The Institute pursues advanced scientific and industrial research in almost all branches of engineering sciences. The institute has worked hand in hand with top industrial and government organization to set up strategic research laboratories and missions for development of next generation technologies.

Whereas, both the parties, have expressed their desire to work together towards developing next generation technology.

NOW THEREFORE, IN CONSIDERATION OF THE FOREGOING PREMISES, THE PARTIES MUTUALLY AGREE TO CO-OPERATE AND COLLABORATE AS UNDER:



BEML- IIT Kharagpur



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1 PROJECT PROPOSALS:

- a. The areas of research interest are given in Annexure I as per the discussion between the Parties. More areas may be identified later.
- b. IIT Kharagpur will form necessary programme groups in each field comprising faculty members from IIT Kharagpur along with officers from BEML.
- c. Individual projects will be identified by IIT Kharagpur and BEML after discussion and mutual agreement. The project proposal will be submitted jointly by investigators from IIT Kharagpur and BEML. BEML will provide grants in aid to IIT Kharagpur as per the approved budget of the individual projects.
- d. The project cost includes an institute overhead as per the prevailing norms (currently at 20% of project cost) of Sponsored Research and Industrial Consultancy, IIT Kharagpur.

2 INTERACTION:

- a. BEML officers may be sent on short-term deputation to IIT Kharagpur for participating in training and research.
- b. During project formulation, faculty members from IIT Kharagpur may visit BEML for technical interactions. BEML will provide free hospitality and reimburse the travel cost for the visiting faculty members.
- c. BEML will interact with IIT Kharagpur and facilitate transfer of technology, as required. BEML will identify officers for continuous interaction with these research groups on a long term basis.
- d. GM, R & D will be the coordinator for BEML, whereas Dean, SRIC will be the coordinator for IIT Kharagpur.

3 DECLARATION: All work undertaken by IIT Kharagpur, as part of the project will be carried out in good faith keeping in view of its application in BEML. During this work, BEML shall attempt in all earnest, to provide necessary support in terms of technical information and expertise, monitoring and advice, technical and financial resources subject to availability and feasibility, for progress, timely and effective execution of the project.

4. CONFIDENTIALITY: Due care will be taken by IIT Kharagpur and BEML to maintain confidentiality and discretion regarding confidential information received by IIT Kharagpur from BEML, and by BEML from IIT Kharagpur, in all aspects, i.e., results, reports, identity, proprietary information etc. to be considered Confidential Information, all written information (including Research Materials) must be duly marked or designated in writing as CONFIDENTIAL by the party providing the information, and oral communications must be reduced to writing within thirty (30) days of the initial communication of the information and such writing must be marked or designated in writing as CONFIDENTIAL. The parties further hereby agrees that confidential information exchanged between the parties shall only be used for the purpose for which it has been divulged and shall not be divulged to any third party without the express leave of the other party. This clause shall survive even after the termination of this MoU.

5 PUBLICATIONS: It is expected that a significant amount of technical publications may result from the work carried out including research papers, books and monographs and student theses. Such publications would be permitted only if the authors submit a jointly signed statement stating that: 1) The said publication does not disclose any confidential information obtained from BEML; 2) It duly acknowledges all financial and technical support received from BEML. Requests for permission to publish to BEML/IIT Kharagpur should be processed and decision conveyed within a maximum of thirty (30) days. In case the publication relates to an IP, necessary steps will be taken for protection of the IPR prior to publication.

6 REPORTS: Any technical report given by IIT Kharagpur will be based on work performed according to available standards and/or open domain literature and shall be property of IIT Kharagpur and BEML. Both parties are entitled to use it in any way that does not violate the provisions of IPR policy mentioned in para 15 and confidentiality as mentioned in para 4 above.

7 TIMELINESS: Every effort will be made to complete the specified work according to the planned time schedule. However, IIT Kharagpur will not be held responsible for delays caused beyond its reasonable control.

8 CONFLICT OF INTEREST: IIT Kharagpur may take up work for other clients also in the same areas of technology, provided, to the best of the institute's knowledge, there is no conflict of interest in undertaking such projects.

9 PROJECT APPROVAL AND MONITORING

- a. A Program Advisory Committee (PAC), comprising officers from BEML and faculty members of IIT Kharagpur will be formed. PAC will approve, administer, monitor and supervise all the R&D related activities coming under this MOU.
- b. A Project Review Committee consisting of all Faculty Investigators of IIT Kharagpur and Project Investigators of BEML shall be formed for interaction and monitoring of stage by stage progress of project and to evaluate/analyse the final technical outcomes. The Committee will submit a Joint Progress Report on six monthly/yearly basis.

10 SCHEDULE OF PAYMENTS

- a. Year wise fund requirement for each project will be submitted by IIT Kharagpur to BEML.
- b. First year fund would be released by BEML before the start of the project. For the subsequent years fund would be released at the beginning of the year based on the utilization of the previous year.
- c. Audited expenditure statement for last year will be submitted by 15th May.

11 MODIFICATIONS RELATED TO PROJECT: Any need for modification in the scope of the project should be proposed by the Principal Investigator of IIT and Project investigator of BEML's and reviewed by PAC giving their recommendations for consideration of BEML and IIT Kharagpur.

12 PROCEDURES OF EXECUTION OF PROJECTS: Procedures of SRIC, IIT Kharagpur shall apply regarding administrative and financial processes related to the projects at IIT Kharagpur

13 CONCLUSION, EXTENSION AND TERMINATION OF PROJECTS: A project may be either extended or foreclosed, if necessary, if recommended by PAC, with or without additional funding, subject to approval. If due to any unavoidable and unforeseen reasons, it becomes necessary to terminate the project, expenditure, including committed expenditure, incurred shall be reviewed and the unutilized amount/items procured against the project will be adjusted at IIT Kharagpur.

14 LIABILITY: IIT Kharagpur shall not be held liable for any loss, damage, delay or failure of performance, resulting directly or indirectly from any cause, which is beyond its reasonable control (Force Majeure). The liability of IIT Kharagpur shall be limited to the funds received for the project.

15 INTELLECTUAL PROPERTY RIGHTS:

Ownership of Inventions conceived, discovered and reduced to practice by IIT Kharagpur, or its employees, agents or students will be owned by IIT Kharagpur. Inventions conceived, discovered and reduced to practice by BEML, or its employees, or agents, will be owned by BEML (Collectively, "Sole Inventions"). Inventions conceived, discovered and reduced to practice by at least one employee, agent, or student of each of IIT Kharagpur and BEML will be jointly owned by IIT Kharagpur and BEML, without any obligation to account to one another ("Joint Inventions"). Inventorship will be determined according to the principles of India's Patent Law. Neither party shall make any claim to the other party's Sole Inventions.

Pre-Existing Rights: Except to the limited extent required to perform a party's obligations under this MOU, neither party receives any right, title, or interest in or to any Research Materials provided to it by the other party or any technology, works or inventions of the other party that are not Inventions, or any patent, copyright, trade secret or other proprietary rights in any of the foregoing.

Patents will mean those Indian and foreign patents and patent applications including any continuation, reissue, or renewal thereof, or substitute therefor, and the patents that may be issued thereon, relating to any patentable Research Program Invention.

Patent Prosecution and Expenses: Unless the parties agree in writing otherwise, the filing, prosecution, defense and maintenance of all Patents for Joint Inventions will be conducted jointly in the name of both parties and controlled by them jointly, acting reasonably and in good faith.

- a. It is expected that research activities under IIT Kharagpur will generate significant Intellectual Property (IP), in the form of Patent, Copyright, Industrial Design, and Semiconductor IC Layout Design. BEML's and IIT Kharagpur's usage of such IP will be conditionless and without any financial impact to BEML and IIT Kharagpur. Licensing of the Intellectual Property to any third party would be carried out individually, keeping the other party informed, after filing patents etc., as applicable for the technology, for protection of its IPR. There will be no royalty charges levied on vendors if the technology developed is used for supplies to BEML and/or IIT Kharagpur. Royalty payments will, however be levied, if the IP is utilized for supply to other than BEML and/or IIT Kharagpur and will be shared equally. In case a contractor / vendor / industry is associated for a particular project, he will only be entitled to free usage of IP for BEML and/or IIT Kharagpur without any proprietary rights.
- b. Patent will be owned jointly by BEML and IIT Kharagpur and will be filed by IIT Kharagpur. Once the application is filed for patent, both BEML and IIT Kharagpur shall be entitled to use it as described above.
- c. Any changes / amendments in IPR policy as mutually agreed between IIT Kharagpur and BEML shall be applicable.

16 EQUIPMENT, SOFTWARE AND HARDWARE: There is a provision for procurement of equipment for the project. After the project is completed in the sense that, all deliverables are transferred and all activities completed, these equipment including software and hardware may be retained at IIT Kharagpur. If not required by IIT Kharagpur, it may be transferred to any specified installation by BEML.

17 HOSPITALITY: Guest House accommodation shall be provided by IIT Kharagpur to concerned BEML officials visiting IIT Kharagpur on project work subject to availability and free of cost. Similar accommodation shall be provided to members of IIT Kharagpur project team if and when they visit BEML.

18 TRANSFER OF TECHNOLOGY: The technology developed under the project will be transferred to BEML. The prototype developed will be the sole property of BEML after transfer. Usage of all developed technology subsequent to transfer shall be governed by the IPR Policy given in clause 15.0.

19 VALIDITY AND TERMINATION: This MoU shall initially be valid for a period of five years, and can be extendable for further period by mutual agreement in writing. The MoU can be terminated by either party by giving three months advance notice in writing. However, such termination shall be without prejudice to the rights and obligations accrued by the parties till the effective date of termination.

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20 RESOLUTION OF DISPUTES: In case of disagreement, the matter shall be referred to a Committee consisting of an official of BEML and Dean (SRIC), IIT Kharagpur for review. The decision of the Committee will be final and binding on both the parties.

On failure to resolve the dispute the matter shall be finally settled by CMD / Director of BEML and Director, IIT Kharagpur in a spirit of independence, mutual respect and shared responsibility.

In the event of any unresolved dispute or difference relating to the interpretation and application of the provisions of this MoU, such dispute or difference shall be referred by either party for Arbitration to the Sole Arbitrator in Department of Public Enterprises to be nominated by the Secretary to the Government of India, in charge of the Department of Public Enterprises. The Arbitration and Conciliation Act, 1996 shall not be applicable to the arbitration under this clause. The award of the Arbitrator shall be binding upon the parties to the dispute, provided, however, any party aggrieved by such Award may make further reference for setting aside or revision of the Award to the Law Secretary, Department of Legal Affairs, Ministry of Law and Justice, Government of India. Upon such reference, the dispute shall be decided by the Law Secretary or the Special Secretary/Addl. Secretary, when so authorised by the Law Secretary, whose decision shall bind the parties finally and conclusively. The parties to the dispute will share equally the cost of Arbitration as intimated by the Arbitrator.

21 AMENDMENT: No amendment to this MoU shall be valid unless it is in writing and signed, by or on behalf of, each of the Parties.

22 ASSIGNMENT: The obligations under this MoU are not assignable without the consent of the other party.

23 PROJECT MANPOWER COST: The project Manpower Cost will be as stipulated in Annexure II to this MoU. However, this may be reviewed every three years.

24 FACULTY TOP UP FELLOWSHIPS:

- a. Faculty top-up fellowships would be payable to Faculty investigators of the project according to mutually decided policy which must meet the guidelines below.
- b. The current value of each faculty top up fellowship is given in Annexure II.
- c. Normally, up to two faculty top up fellowship amounts shall be payable per project. In exceptional cases, it will be permitted to pay up to three faculty top-up fellowship amounts subject to approval of PAC. Within this amount the number of faculty members may be two, three or more and the amount will be distributed from this total.
- d. Faculty top up fellowship shall be payable only for the duration of the project proposed and not for the period for which the project may be extended due to delays in executing the project.
- e. The faculty top up fellowship for the last year would be released only after the completion of the project.

25 PAYMENT TO EXTERNAL EXPERTS: External experts identified by Principal Investigator of IIT Kharagpur team may be engaged purely on need basis and only when related expertise available in IIT Kharagpur or BEML is not suitable, subject to approval of PAC. Payment to external experts should be restricted to one faculty top-up fellowship. However, additional expenses towards transport, not including international travel, and local hospitality for projects is admissible as per SRIC IIT Kharagpur norms for such experts.

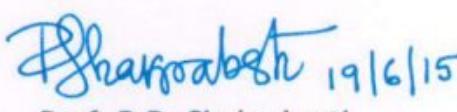
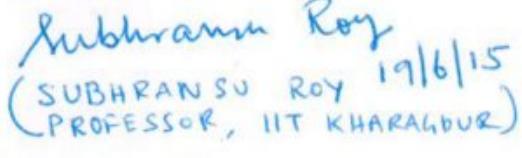
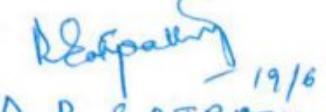
26 INTERNATIONAL VISIT: International visits of members of IIT Kharagpur Project team and members from BEML are admissible for upgradation of expertise (workshops, academic interactions, conferences, etc.) under the project. However, actual international visit will be

strictly need based. It will require technical approval from PAC, administrative approval from IIT Kharagpur or BEML, as the case may be.

27 HRA AND MEDICAL EXPENSES/INSURANCE: Accommodation, medical facility and group medical insurance to project staff shall be as per existing practices of SRIC IIT Kharagpur. However, HRA for project staff staying outside campus if in-campus accommodation is unavailable, any substantial medical expense that may be incurred due to unforeseen emergencies, and medical insurance charges for project staff are to be met from Contingency head of the project as per existing SRIC policies.

The MOU will be operative from 19th June 2015 and any alteration/modification may be carried out with the consent of both parties.

The parties hereto, have caused this MOU to be signed in their respective names as on the day and year first above written.

| For and on behalf of BEML Limited | For and on behalf of IIT Kharagpur |
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|  19/6 Sri. Aniruddh Kumar Director - Rail & Metro ANIRUDDH KUMAR Director (Rail & Metro) BEML Limited, Bangalore Complex, New Thippasandra Bangalore - 560 075. |  19/6/15 Prof. P.P. Chakrabarti Director - IIT Kharagpur Prof. Partha P. Chakrabarti Director Indian Institute of Technology Kharagpur Kharagpur - 721302, India |
| <u>Witness:</u> 1.  19/6/15 (AMIT BANERJEE) GM, R&D, BEML 2.  19.06.15 (K. PRAKASH) DGM, R&D, BEML. | <u>Witness:</u> 1.  19/6/15 (SUBHRANSU ROY) PROFESSOR, IIT KHARAGPUR 2.  19/6 D.P. SPATNAIK AGM - HR, BEML |

Annexure I
(MoU between BEML Ltd. & IIT Kharagpur; Dtd. 19th Jun 2015)

Proposed Areas of Co-Operation

| AREA | DESCRIPTION |
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| Bogie design & rail vehicle dynamics | Study on Bogie design methodology for use on EMU's for speeds of 160 –200 kmph. Study on various parameters like wheel profiles, curve negotiation, wheel unloading, derailment factors, damping, kinematic linkage analysis, ride quality, wheel flange lubrication, torsional stiffness, etc |
| Noise & Vibration in Rolling stock | Predicting the interior & exterior noise in a metro train using software tools, design considerations for noise & vibration mitigation, international standards |
| Crash performance | Methodology to be adopted for crash analysis, crash analysis of carbody/ full train, energy absorption / dissipation of various aggregates and factors affecting the same based on international railway standards. |
| Static & Fatigue analysis | Setting of our existing Static and Fatigue analysis procedure (Goodman Method) for bogie frame structure. Suggestions/improvement over the methodology may be suggested. Alternatively, different approach for fatigue analysis used for railway application may be indicated. |
| Spot welding & other joining methodologies | Study on design considerations for use of spot welding on rolling stock with austenitic stainless steel, strength analysis, test methods, standards specific to rolling stock. Study on sealants & adhesives and alternate makes |
| HVAC for Rolling stock | Study on design principles for complete HVAC system, HVAC components, heat load calculations, CFD analysis for thermal comfort, test methods –unit & vehicle level based on international standards. |
| Alternate materials: Carbody & Bogie Rubber profiles | Study and suggestion on use of different SS materials for carbody. Alternate grades for austenitic stainless steel being presently used on metro cars. Development of SN curve for the materials SMA 490 and austenitic SS being used in metro cars. Development of rubber profiles confirming to fire safety standards BS-6853 class -1a (fire, smoke and toxicity) |

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| System Engineering | Establishing methodology for the following: Reliability, Availability, Maintainability & System Safety Noise & Vibration Electro Magnetic Compatibility Fire performance |
| Railway traction systems design | Design Principles –3 phase IGBT based VVVF controlled Traction Power line, Regenerative Braking. Design Principles of Converter-Inverter/Inverter & Static Inverter. Train Performance simulation |
| Train control system engg | Train control Management system(TCMS) Study of basic architecture at hardware & software level & integration with on-board equipment |
| EMI / EMC | Study on EMI/ EMC conformance of Rolling stock to relevant standards –Design issues. |
| Testing jig | Development of integrated electrical testing jig for metro cars. |
| OHE Inspection | Automated on-line monitoring system |

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Annexure II
(MoU between BEML Ltd. & IIT Kharagpur; Dtd. 19th Jun 2015)

Project Manpower Cost

1. Payment to Research Personnel

- i For Research Engineer (Grade-III) having Ph.D. qualification or equivalent - up to Rs. 65,000/- p.m.
- ii For Research Engineer (Grade-II) having M.Tech qualification or equivalent - up to Rs. 50,000/- p.m.
- iii For Research Engineer (Grade-I) having B.Tech qualification or equivalent - up to Rs. 36,000/- p.m.
- iv For Research Consultant (full-time or part-time) having M.Tech qualification or equivalent and industrial/practical experience in the relevant field - up to Rs. 75,000/- p.m.

2. Payment to other Project Staff

- (i) For Technical Officer/Junior Technical Officer/Senior Technical Assistant (TO/JTO/STA) having Diploma in Engineering or equivalent - up to Rs. 22,000/- p.m.
- (ii) For Technical Assistant/Junior Technical Assistant (TA/JTA) having Vocational training in different trades or equivalent - up to Rs. 15,000/- p.m.
- (iii) For Project Officer/Junior Project Officer/Senior Project Assistant (PO/JPO/SPA) having Bachelors/Masters or equivalent - up to Rs. 22,000/- p.m.
- (iv) For Project Assistant/Junior Project Assistant (PA/JPA) having Bachelor's degree or equivalent - up to Rs. 15,000/- p.m.

The exact remuneration would be decided by the Selection Committee depending on academic records, experience, and performance in the selection process following prevailing norms of SRIC.

Faculty top-up fellowship: The value of each faculty top up fellowship will be upto Rs. 4.0 lakhs per year. The total requirement of faculty top up fellowship shall be divided among the participating faculty in an appropriate manner, depending on their stated involvement in the project and must follow the prevailing norms of SRIC.

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