REQUEST FOR INFORMATION (RFI) FOR INDIGENOUS DEVELOPMENT OF TRUNCATED LITHIUM ION BATTERY SYSTEM FOR SUBMARINES

1. The Ministry of Defence, Government of India, intends to undertake Indigenous Development of 500KWh Lithium Ion Battery system for Submarines.

2. This Request for Information (RFI) consists of two parts as indicated below:-

(a) **Part I.** The first part of the RFI incorporates operational characteristics and features that should be met by the vendor. A few important technical parameters of the proposed repair facility are also mentioned.

(b) **Part II.** The second part of the RFI states the methodology of seeking response of firm.

PART- I

3. **Purpose**. The Intended use of the Lithium Ion Battery system for Submarines could be replacement of the existing Lead Acid batteries fitted onboard conventional submarines and fitment as a power source on the new submarines under procurement/ construction. The QRs are placed at **Appendix 'A'**.

4. **Quantity Required and Anticipated Delivery Timeframes**. Once proved, the Lithium Ion battery system would be scaled up 5MW for fitment onboard conventional submarines. Anticipated Quantity - 06

5. **Important Technical Parameters**. Operational/Technical requirements are placed at **Appendix** '**A**' of this document. Further, following details are to be submitted:-

(a) Feasibility to manufacture equipment with the enclosed Operational/Technical Requirements (**Appendix** '**A**'). Any modification to the specifications can be suggested by the OEM with suitable justification.

(b) Budgetary quotes with breakup of cost including factors such as Product Design, Training, and Testing etc. Cost not to include custom duty/ tax component.

(c) Build Period.

(d) Experience in manufacturing similar equipment along with client details.

(e) Memorandum of Understanding, if any, with respect to design aspects.

(f) Willingness for Option clause, including the duration for which the Option Clause would be valid.

(g) Firm may consider RFI as advance information to obtain requisite government clearances.

(h) The tentative delivery schedule for supply of the equipment after conclusion of the contract.

6. **Additional Specifications**. The aim of seeking this RFI is also to finalise the specifications for the said equipment with inputs from OEMs. Accordingly, a questionnaire is placed at **Appendix 'B'**. The questionnaire at **Appendix 'B'** also needs to be answered.

7. The Vendor should confirm that the following conditions are acceptable:-

(a) Solicitation of offers will be as per 'Two Stage - Two Bid System'. It would imply that a 'Request for Information' would be issued soliciting the technical and commercial offers together, but in two separate sealed envelopes. The validity of commercial offers would be at least 18 months from the date of submitting of offers.

(b) The technical offers would be evaluated by a Technical Evaluation Committee (TEC) to check its compliance with RFP.

(c) The Firm would be bound to provide product support for time period specified in the RFP, which may include spares and maintenance tools/jigs/fixtures/documentation for training for field and component level repairs.

(d) **Integrity Pact**. An Integrity Pact along with IPBG is a mandatory requirement in the instant case (refer Annexure I to Appendix M of Schedule I).

(e) **Performance-cum-Warranty Bond**. A Performance-cum-Warranty Bond both equal 10% of value of the contract is required to be submitted after signing of contract.

PART-II

8. **Procedure for Response**.

(a) The firm must fill the form of response, as given in ***Appendix C of this document***. Apart from filling details about the frim, details about the exact equipment meeting the mentioned operational / technical specifications (**Appendix A** and **Appendix B of this document**) should also be carefully filled. Additional literature on the equipment can also be attached with the form.

(b) The filled form should be dispatched to the under mentioned address: -

The Commodore (Electrical Engineering)
Directorate of Electrical Engineering
IHQ-MoD(N) / DEE, D-II wing, Sena Bhavan,
New Delhi 110011 India.
Tele: +91-11-2301 1116
Fax : +91-11-2301 1212
E-Mail: dee@navy.gov.in

(c) The last date of acceptance of reply is **4 weeks** from the date of issue.

9. This information is being issued with no financial commitment and the Ministry of Defence reserves the right to change or vary any part thereof at any stage. The Government of India also reserves the right to withdraw it should it be so necessary at any stage.

Appendix A

AIM OF THE DEVELOPMENT PROJECT

1. The project aims to develop High capacity Lithium Ion Battery (LIB) system that is scalable for building a full stack Lithium-ion battery system for existing conventional submarines of the *IN*. The total capacity of Lithium Ion battery system is envisaged to be not less than 500 KWh which should be scalable upto 5 MWh.

Scope of the project

2. The scope of the project envisages the following:-

(a) Design of a 500 KWh Lithium Ion battery system for demonstration purpose.

(b) Selection and characterisation of Li ion chemistry for making a cell that would be provide maximum capacity and robust safety.

(c) Study and design of system architecture (arrangement of Li Ion cells in parallel or series).

(d) Design and development of the Battery Monitoring System (BMS).

(e) Development of Acceptance Test Protocols for the Lithium Ion Battery module.

(f) Charge and discharge characterisation of the LIB along with the BMS.

(g) Study report on overall demonstrator system for scalability and retro fitment onboard conventional submarines.

Timelines for the Project

3. The project is envisaged to be completed within 20 months from award of contract. With 'D' as the date of signing of contract, the following timelines are envisaged:-

(a) Finalisation of system Design and configuration - D + 3 months

(b) Demonstrator System development - D + 15 months

(c) Testing and Validation - D + 20 months

(d) Report on Demonstrator system functionality and scalability for retrofit - D + 24 months.

Design of LIB

4. **Capacity and Dimension of LIB system**. The LIB is to be designed for retro fitment in lieu of Type I batteries. The dimensional specifications of the battery system are therefore restricted to the dimensional details of the Type I battery cell. Considering that the existing volume of Type 1 batteries is 0.29 m^3 (L-658 mm, B-369 mm, H – variable max -1500mm) and a total of 120 cells can be fitted inside a battery set. It is desirable that the

new design of the battery module should be limited to the dimensions of the existing cell. However the number of cells can vary depending on the total voltage requirement of LIB system which is considered to be from 240V-280V. It is envisaged that the Voltage of a module would also be around 240V-280V and all the modules would be connected in parallel to achieve the same LIB system voltage. Effectively, the power output per module would be 500 KWh which should be scalable upto 5MWh.

5. **Sourcing of Li Ion Cells**. The design is to be based on either imported / indigenous Li Ion cells. If imported cells are used for the development project, the volume for encasing the cells is to be chosen such that it is amenable to be changed later with an indigenous cell, if available. The choice of chemistry of the Li Ion cells along with report for testing and evaluation need to be finalised along with the design documents.

6. **Configuration of Cells inside Modules**. Considering that the LIB development is meant for evaluation for its suitability for retro-fitment, the module has to meet the existing Voltage and current requirements of the Type I battery. Accordingly, the configuration of the Li ion cells inside a LIB is to be chosen such that it meets the overall voltage level requirements of the battery group (240V-280V) and the existing PGD network of the EKM class of submarine. The option for series, parallel or a combination arrangement of Li Ion module thus need to be evaluated for the battery group and thereafter a suitable arrangement for Li ion cells needs to be selected for the LIB.

7. **Battery Management System (BMS)**. The LIB has to be designed with an integrated Battery Management System. The BMS is to include sensors for current, voltage and temperature along with switch gear arrangement for isolation of erratic cells/ sub-module /module and short circuit protection device for the module. The BMS design has to cater for safe exploitation during charging and discharge cycles of the module. Based on the operational parameters for the constituent Li ion cells, the BMS has to cater for continuous monitoring of parameters, auto balancing of voltage and implement a protection sequence with graduated mode of evolution from warning to isolation of erratic cells/ sub module/ module. The BMS has to display exploitation parameters of the cells and facilitate active monitoring/ intervention in case if required. The BMS has to record parameters and generate advice *wrt* to state of charge of the module during charging/ discharging of the battery. The design therefore has to cater for an integrated BMS in the module and Interactive central control and display unit. **The design architecture of the BMS is required to be finalised in consultation with the *IN*.**

8. **Safety and Protection Design**. The following safety aspects are to be catered in the design:-

(a) **Cell level**. The Li Ion cell to be selected with a safety vent, and overcharge safety device.

(b) **Cell tray/ submodule level**. At the sub-module level, safety features of BMS are to be integrated for monitoring and isolation.

(c) **Module level**. The LIB module has be integrated with a management device along with a power relay assembly device.

(d) **System level**. The battery management system is to provide management for string of modules along with short circuit protection device.

9. **Testing Levels**. The following testing is envisaged for the various components of the LIB system :-

(a) **Cell**. Test for cell runaway conditions.

(b) **Battery Module**. Study propagation behavious within the battery module and thermal energy release outside of the module.

(c) **Battery Unit**. Test of the configuration of unit to unit fire spread with heat release rate and gas analysis to determine potential for explosion.

(d) **System Integration**. Closed room test configuration of unit to unit fire spread with fire mitigation equipment.

10. **Test Protocols**. The prototype LIB system has to tested for energy output at various discharge rates to validate capacity. The test protocols are to include the following details:-

(a) Electrical performance
  (i) Discharge rates at C_1, C_3, C_5, C_{20}, C_{50} and C_{100}.
  (ii) Insulation test.
  (iii) Charge retention test
  (iv) Internal resistance test.
  (v) Charging time.
  (vi) Warranted capacity test.
  (vii) Life Cycle test.

(b) Safety Test
  (i) Over charge and Over discharge test.
  (ii) Short Circuit.
  (iii) Heat exposure.
  (iv) External fire exposure.
  (v) Salt water immersion.
  (vi) Safety function test of BMS.

(c) Reliability test.
  (i) Weight and dimensions.
  (ii) Tilt Test.
  (iii) Immersion test
  (iv) Shock test.
  (v) EMI/ EMC test

Appendix B

QUESTIONNAIRE FOR INDIGENOUS DEVELOPMENT OF 500 KWh TRUNCATED LITHIUM ION BATTERY SYSTEM FOR SUBMARINES

1. What are the comments on proposed Delivery Schedule of the equipment?

2. What is the capacity/ infrastructure of the firm to meet the delivery schedule?

3. What would be the approximate cost of the equipment and the financial capability of the firm to undertake the project?

4. What is the past experience of firm in similar projects?

5. Details to be submitted for generating/ refining/ rationalizing the QRs prior issuance of RFP (Appendix A).

6. Furnish details that go into determining the cost of the scheme, including factors such as Design, training, Testing etc.

7. Furnish details of capability clearance certificate to indigenously design and develop the required equipment.

8. What are the applicable key technologies and materials required for manufacturing of the equipment/ system and the extent of their availability or accessibility in case they are not available in India?

9. What is the approximate cost estimation and suggestions for alternatives to meet the same objective as mentioned in RFI?

10. What are the capabilities of Indian firm to Indigenously Design, Develop and Manufacture (IDDM) the required equipment?

11. Availability of the equipment/system in the Indian market, level of indigenization, delivery capability, maintenance support, life time support etc.

Appendix C

INFORMATION PROFORMA

1. **Name of the Company/Firm/** _____

_____

_____

(Company profile, in brief, to be attached).

2. **Type (Tick the relevant category)**

Original Equipment Manufacturer (OEM) - Yes/No

Authorised Firm/ - Yes/No

(attach Firm details, if yes)

Others (give specific details)_____

_____

_____

3. **Contact Details**

Postal Address : _____

_____

_____

City :_____ State :_____ Country:_____

Pin Code: _____ Tele :_____

Fax : _____ URL/Web Site:_____

4. **Local Branch/Liaison Office in Delhi, India (if any)**

Name & Address _____

_____

Pin Code:_____ Tele:_____ Fax:_____

5. **Financial Details**

(a) Category of Industry (Large/medium/small Scale):_____

(b) Annual turn over:_____(in INR)

(c) Number of employees in firm:_____

(d) Details of manufacturing infrastructure :_____

_____

(e) Earlier contracts with Indian Ministry of Defence/Government agencies:-

Contract Number	Equipment	Quantity	Cost