



Technical Parameter Requirement (TPR)

*Recovery of Lithium precursors from used
Lithium ion batteries*

(Opened for Start-ups Only)

**Directorate of Technology Development Fund
(DTDF), DRDO HQr, DRDO Bhawan,
Rajaji Marg, Ministry of Defence,
Government of India
Delhi -110011**

TECHNICAL PROJECT REQUIREMENT

Recovery of Lithium precursors from used Lithium ion batteries

Introduction:

The increasing demand for use of Lithium ion batteries for electric vehicles (EV) is a concern due to the scarcity of Lithium reserves. Recycling of Lithium from spent batteries is one of the solutions to meet the demand. Recycling of Lithium ion batteries also helps in neutralizing the harmful chemicals and recovery of aluminum and copper electrode foils used in the battery.

The source of Lithium in the Lithium ion batteries is from the cathode materials viz., Lithium cobalt oxide, Lithium Iron Phosphate, Lithium Magnate etc., used for different applications. Among these cathode materials, Lithium Iron Phosphate is most preferred for EVs due to their higher material safety features and higher current of discharge.

Selective dissolution of Lithium from used Lithium Iron Phosphate batteries by use of acidic solutions and precipitating the Lithium in the form of Lithium carbonate is one of the feasible routes as the Lithium carbonates can be used as precursors for synthesis of Lithium Iron Phosphate cathode. Development of a commercially viable route for recovery of Lithium from the Lithium Iron Phosphate batteries will be useful for meeting the demand of these batteries in long run.

The objective of this development is recovery of Lithium precursors from used batteries using commercially available chemicals, develop a commercially viable, eco-friendly process and scaling up the technology to industry level. The recovery of Lithium precursors involves understanding the chemical reactions and analyzing the crystal structures of recovery products. The detailed technology parameter requirements are given below.

Technology Parameter requirements:

- The used Lithium ion batteries in discharged condition will be given for recovery of Lithium Iron Phosphate (LiFePO_4) cathode powder. The dissection of the used

batteries is to be carried out in glove box / fume hood to separate the electrolyte, cathode material, anode material, aluminum and copper foils. Neutralization / recycling method for the safe disposal of the electrolyte is to be developed.

- The used cathode powder contains mixture of Li_xFePO_4 , carbon and Polyvinylidene fluoride binder. The Lithium from the used LiFePO_4 cathode powder is to be recovered using solvent extraction methods using commercially available chemicals to obtain Lithium carbonate as it is a precursor for synthesis of fresh LiFePO_4 . One of the known methods is use of sulphuric acid for selective leaching of Lithium and precipitating Lithium carbonate by using sodium carbonate solution.
- Any other commercially viable and safer methods for producing Lithium precursors for LiFePO_4 can also be adopted.
- The process parameters like pH, leaching time, temperature etc., are to be optimized to ensure the obtained Lithium carbonate is in the purest form comparable (in terms of composition and crystallographic structure) to that of commercially available Lithium carbonate.
- Minimum batch size recovery from 1 kg of used LiFePO_4 powder should be demonstrated in this project. The developed technology should be commercially viable, eco-friendly and easy to upscale to industrial level.
- Synthesis of fresh LiFePO_4 from the recovered Lithium carbonate to be carried out in a batch of 50-100 g and the performance of the synthesized LiFePO_4 cathode material will be tested using CR2032 coin cell / pouch cell at NSTL. LiFePO_4 cathode synthesized from the recovered product should have specific energy density > 100 mAh/g and cycle life of minimum 1000 cycles at C/10 rate of discharge.
- For the process of recovery of Lithium carbonate from used LiFePO_4 and synthesis of fresh LiFePO_4 from recovered Lithium carbonate, literature available in internet may be explored. All safety conditions, norms and standards to be followed.
- Detailed report is to be prepared containing information on the recovery process, optimized parameters, composition of the recovered product, crystallographic structure, particle size, recovery percentage, commercial viability and performance of the LiFePO_4 cathode material synthesized from recovered Lithium carbonate.

Deliverables:

1. Technology for recovery of Lithium precursors from used LiFePO_4 based Li-ion batteries along with complete documentation covering the entire recovery process, list of chemicals used, optimized parameters and commercial viability.
2. Recovered Lithium precursor powder (preferably Lithium carbonate) minimum quantity of 500 g in 1 to 4 batches for synthesis of LiFePO_4 at NSTL.
3. Test reports of the complete composition analysis, crystal structure and particle size for all the batches.

Test methodology and acceptance criteria:

1. The firm has to initially develop the recovery process in smaller batch and later demonstrate recovery from minimum 1 kg batch of used LiFePO_4 powder.
2. The composition of the recovered product is to be tested using Inductively Coupled Plasma Spectrometry (ICP) or equivalent chemical analytical methods to confirm the composition. The purity of the recovered product should be minimum 99%.
3. The crystal structure of the recovered product is to be tested and analyzed using X-Ray Diffractometer (XRD) to confirm the formation of pure Lithium carbonate (Li_2CO_3) with Monoclinic structure.
4. LiFePO_4 cathode powder synthesized from the recovered product should have specific energy density > 100 mAh/g and cycle life of minimum 1000 cycles at C/10 rate of discharge.

TERMS & CONDITIONS

1. Technology Development Fund (TDF) has been established to promote self- reliance in Defence Technology as a part of the 'Make in India' initiative. It is a programme of MoD (Ministry of Defence) executed by DRDO meeting the requirements of Tri-Services, Defence Production and DRDO.
2. The scheme encourages participation of public/private industries especially start-ups so as to create an eco-system for enhancing cutting edge technology capability for defence application.
3. Engagement of start-ups under TDF scheme shall normally for the projects having estimated cost less than INR 1 crore.
4. Such engagement is primarily for Nascent Start-ups (i.e. start-ups having been incorporated less than 3 (three) years ago from the date of application submission). Other Start-ups (i.e. start-ups that have been incorporated more than 3 (three) years ago from the date of application) shall be considered if no Nascent Start-ups, applying under the scheme, is found suitable for the project. Although Nascent Start-ups shall be given preference, the scheme shall be open to both kinds of Start-ups.
5. Nascent Start-ups applying to the TDF Scheme, should be attached / associated with a government-aided or government-recognized incubator.
6. The role of incubators is to provide all necessary support to Start-ups for the execution of the project as per Design Document and such incubators may charge fee for providing working space, mentoring, business planning, IPR, Legal support. However, the contribution of incubators under the Scheme shall not be more than 20% (twenty percent) for any project proposal and included in the total project cost.
7. The Start-ups and Incubators need to submit their DIPP / DPIIT certificate and Start-Up registration details, along with other mandatory documents while participating in the Scheme.
8. The funding will be through provision of grant to Start-ups that may also work in collaboration with the academia or research institutions to carry out innovation, research and development. However, the contribution of such academia / research institution shall not be more than 40% of the total project cost.
9. Submission of Project proposal doesn't guarantee any commitment under this Scheme from DRDO / DTDF.

10. Suitable technical information will be provided to the Start-ups on submission of NDA (Non-Disclosure Agreement) during technical interaction meeting on 'need to know' basis.
11. The Start-ups shall submit a compliance statement for all the eligibility requirements with necessary supporting documents for scrutiny.
12. SOFT / Type Approval (CEMILAC Certification) is required for all airborne systems / subsystems. The details of certification process can be seen in the guidelines published on TDF Website.
13. Any Start-up can have concurrently, maximum of 3 TDF Scheme projects (Maximum 2 as Lead DA) either as lead DA or as consortium partner.
14. The Start-ups shall submit all information about their executed / ongoing / applied projects under TDF scheme during the submission of project proposal.
15. The transfer / sharing of IPR will be carried out under DRDO through a committee of constituted by DRDO. In addition, filing of Patents and other IPR protection will be carried out by DRDO as per extant guidelines & policy of DRDO.
16. Only equipment essential for execution of the project will be considered for funding under TDF Scheme. The essentiality of the equipment will be established through a nominated committee of technical expert.
17. Any Start-ups providing false information will be liable for action as per existing MoD guidelines.
18. In the event that any of the applicants or prospective awardees under the TDF Scheme have availed of, been awarded or secured a grant-in-aid or any other form of monetary assistance from Government institution for same / similar technology before applying to the TDF Scheme or during their execution of the Project, the same must be disclosed to DTDF within 30 days of change in status.



Defence Research & Development Organisation

Technology Development Fund

Project Proposal Form - Part A: Technical Form

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NOTE:

1. The Authorized Representative for the Start-up is required to sign and seal all the pages.
2. The Time Period for Submission of the Proposal Form is 30 days from the date of issue.
3. **Price Bid to be submitted in Part B only. In case, Part-A contains Price Bid, the proposal will be summarily rejected.**
4. The SOP and Terms and Conditions and other details as listed on TDF Website are applicable for the scheme.
5. All sections of Proposal Form are mandatory



6. Please do not make any changes to the contents of the form

Project Name:

Section 1: Basic Information

- ① All fields are mandatory in this section
- ⚠ Do not change the contents of this form, any change detected will result in the rejection of the application.

1. **Organisation Name:**
2. **Organisation Type:** [Click here](#)
3. **DPIIT Registration Number:**
4. **Attach DPIIT registration certificate:**
5. **Registered Address:**
6. **Designated Contact Person:**
7. **Email Address:**
8. **Contact Number:**
9. **Position/Designation:**

Section 2: Profile

Subsection 1: Principal Investigator

- ① All fields are mandatory in this section

1. **Name:**
2. **Qualification:**
 - a. **Education**
 - b. **Work Experience**
3. **Designation**
4. **Phone:**
5. **Email:**
6. **Please attach Resume**



- Note: Attach pdf/ doc with file name: Resume-PI-Name

Subsection 2: Organisation

- Please add rows in tables as required

1. Profile/ Description (Min 150 words):

2. Details of Directors

S. No.	Name	Mobile No.	Resume	Nationality	Edit
				Click here	

3. Details of Investors

S. No.	Name Of Individual/ Company	Amount Invested (In Inr Lakhs)	Share Holding Pattern (In %)

4. Year Established: < 0 – 36 months>

- Should not be incorporated for more than 3 years from date of submission of application

5. Indian Ownership: Yes / No

- At least 51% ownership stake held by an Indian citizen or entity to be considered an Indian entity):

6. Size of Team:

7. Qualifications of the Team Members:

S.no	Name	Designation	Mobile	Resume	Additional Information
				Note: Attach with file name: Name- Startup-Position	



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8. Memorandum of Association of Company:

a. Article of Association Company:

- Note: Attach with file name: memorandum_of_association-Industry Name

b. Audited Financial Statement (Annual Report and Balance Sheet)

- Note: Attach with file name: Annualreport-Industry Name

9. Incubator Name:

- Startup should be incubated at one of the Central/State government assisted incubators

10. Attach a proof of Incubation:

11. Attach corporate presentation:

- Should include details about the Incubator
- Limit: 08 slides

Subsection 3: Incubator

1. Coordinator Name:

2. Email:

3. Phone:

4. State:

5. Incubator supported/assisted by GoI

- Give details of the support and the supporting Govt agency

6. No of startups supported by incubator:

7. No of startups supported in Defence and Aerospace sector:

8. Copy of Incubator & Industry MoU

- Note: Attach with filename- MoU-Incubator



Section 3: Project Implementation Information

1. Expected Project Duration (in Months): **<0 to 24>**

2. Consortium Partners (if any):

- ① Attach SOC
- ① Details of work share by the Consortium partner

3. Academic Partner, if any.

- ① Attach SOC

4. Project Location State and City:

5. Has the Startup received any grants/grants-in-aid by any government scheme for a similar technology: **Yes / No**

- ① If Yes, then elaborate on the support received from and amount received

6. Any awards received in the past by for a similar technology: **Yes / No**

- ① If Yes, then elaborate on what the award and the awarding agency

7. What is the Indigenous design capability of the Startup along the Incubator in subject field (% Indigenous Content in the proposed technology development):

8. Is the company debarred/banned/blacklisted or the business dealings with whom are “suspended”/ “put on hold”, by the Ministry of Defence : **Yes/ No**

- ① Refer to Appendix A of TDF SOP

9. Have you applied for another project in the TDF Scheme: **Yes/ No**

- ① If Yes, please add rows as required

S.no	Project Name	Stage	As DA/ CP



Subsection 2: Cost head Expenses Details



- A. Academia - Not more than 40% of total cost
- B. Contingency - Not more than 3% of total cost
- C. Overhead - Not more than 10% of total cost
- D. Incubator - Not more than 20% of total cost

S.no	Cost Head	Justification	Percentage Contribution	Milestone
	Manpower			Select Milestone #
	Equipments/plant & machinery details			
	Consumables			
	Academia			
	Contingency			
	Overheads			
	Travel			
	Subcontract			
	Incubator			



Section 4: Application

Subsection 1: Project Details

1. Broad understanding of the project:

- ① Define your understanding about the problem and what will be the final outcome/deliverables

2. Elaborate the proposed technical solution for this requirement and the end outcomes:

3. Please attach a concept note explaining the technology with necessary figures and diagrams

- ① Note: Please attach with filename: Conceptnote-Projectname-Industryname



4. Road map for achieving the proposed outcome/deliverables:

- ① The description should cover the following points:
 - Strategy and/or methodology of work.
 - Scope and boundaries of the work, including any issues that will not be covered.
 - Data analysis (sample size, data collection)

5. Describe the specific innovation in the proposed solution and its novelty:

- ① Explain how your idea is innovative and how it is different from the existing products in the markets or current state-of-the-art. Tabular representation of the difference between your idea and the other products in market or competitive product which are under development will be appreciated. Concrete market data is encouraged. Comparison vis a vis global tech available in terms of quality and cost.

6. Percentage Indigenous Content: _____%

7. Details of Equipment Needed for the Development:

- ① Please add rows as required

S. No	Name of equipment	Application in the project development



8. Execution of projects pertaining to critical technology area in the past:

9. Execution of projects for military users in India and abroad in the past:

- ❗ Number of development projects executed for military users in India or abroad and their value in terms of Indian currency
- ⚠ Maximum value in terms of Indian currency will be taken as reference and then accordingly rest proposals will be given marks proportionately

10. Execution of projects for other users in India and abroad in the past (If any):

- ❗ Number of development projects executed for other users (other Ministries/Department) in India or abroad and their value in terms of Indian currency
- ⚠ Maximum value in terms of Indian currency will be taken as reference and then accordingly rest proposals will be given marks proportionately

11. Plan proposed for executing current project:



12. Attach Technical Presentation:

- ① Detailing the development approach
- ① Limit: 10 slides
- ① Note: Please attach with filename: TechnicalPresentation-Projectname-Industry name

13. Elaborate on the Inter-operability across the Services/Potential for dual use/ Export Potential:

14. Relevant References:

- ① Please enter references that might have been utilised in creating the proposal and are helpful for Technical Committee.

15. Attach Additional Documents (You may Attach any other document relevant to the project execution/ planning):

16. Please download the attached Undertaking document, fill the necessary columns and attach:

- I certify that I have made no changes to the Undertaking document and have filled the necessary fields as is. I understand that any change of language discovered in the attached document may result in the application being dropped.



Subsection 2: Market Analysis

1. Opportunity

- ① What is the potential societal and market impact?
- ① Provide details of the problem you propose to solve.

2. Challenges or risk factors associated with the project

- ① What are the challenges and risk factors that you envision which may affect this project?
- ① What are the critical success factors/potential barriers

3. Has any preliminary work been carried out? Give status of work done? If no, please provide the background details.



4. Future Plan of Commercialization

- ① What do you envision to be the key next step to making impact with this innovation (e.g., sponsored research support, licensing, venture financing)? What is the time frame?]
- ① Commercialization plan should indicate :
 - Market entry strategy.
 - Timelines and Milestones.
 - Data analysis (sample size,data collection)

7. Relevant References:

- ① Please enter references that might have been utilised in understanding the market

8. Please attach declaration document on ethical/legal/safety/regulatory issues involved, if any :

- ① Note: Attach with filename- Ethical/legal/safety-Industryname

9. Please attach any certification available with you or the Incubator (ISO/ Cemilac/ Fire Safety, CMM, etc)



Subsection 3: Milestones

1. Technical Milestones vis-à-vis Timeline for project delivery (The project should have four milestones maximum)

① Financial Contribution: What % of funds would you require for the particular milestone

S. No	Milestone	Duration (months)	Financial Contribution (in %)
1		<input numbers>	
2			
3			
4			

a. Technical Milestones Deliverables

S. No	Milestone	Milestone Name	Description	Percent Lead DA	Percent Milestone Work
				<number from 0 to 100 with 2 decimals allowed>	< number from 0 to 100 with 2 decimals allowed>



Section 5: Organisation Overview

i Please add rows in tables as required

1. Turnover: Rs _____

2. Investment in R&D in Last Three Years:

S. No	Financial Year	Amount

3. Indigenous manufacturing capability (plant and machinery) (with Startups/Incubator Partner)

S. No	Equipment Name / Capability	Product Make	Quantity	Remark

4. Patents: Yes / No

- Does the applicant or the applicant company own any IP related to this project. If yes, give details.
- List Of Patents That Appear to Cover Any Part Of The Technology Of Interest Or Similar (And Possibly Overlapping) Technologies And Thereby Restrict The Freedom-To-Operate In The Envisaged Area. (Please mention Patent Number, Patent Title and Patent Assignee)
- If there are patents that are overlapping and may restrict FTO, does the applicant have the required license/s to practise these inventions for the purposes of the proposed project? Please provide license agreement details if any or provide information of the proposed next steps to obtain said license/s.

S. No	Name of Inventor	Number	Title	Filed By	Filing Date	Status	Usage in applied Project	Additional Info
						<Pending/ Approved>		



5. Publications

- ① List of publications that might be relevant to the project.

S. No.	Title	Author	Journal of Publication	Year of publishing	Relevance to Project

6. Products/ Technologies

- ① List of technologies or products developed that might be relevant to the project.

S. No.	Technology Name	Stage of Development	Year of development	Relevance to project

7. TOT (Terms of Technology Transfer)

S. No.	Technology Name	Organisation Name	Mode	Year
			<Received/Pending>	

8. Details of involvement in TDF projects:

	As Lead DA	As Consortium Partner
Project Completed		
Project Short Closed		
Project currently under execution		
Project Currently applied for		



Section 6: Statement of Cooperation & Certification

Project Title:

- (a) The Following Parties do hereby irrevocably constitute an Association of Persons/ consortium (the "Consortium") for the purposes of jointly participating in the bidding process for the TDF Project and executing and implementing the complete "TDF" project upto the completion of the technology/prototype development that MoD places on the AOP.
- (b) The Following Parties hereby undertake to participate in the "TDF" Project only through this AOP Agreement and not individually and/ or through any other AOP / consortium constituted for this Project, either directly or indirectly or through any of their Associates.
- (c) The Following Parties do hereby undertake to be jointly and severally responsible for all obligations and liabilities relating to the Project and in accordance with the terms of the EOI and subsequently in accordance with the development contract, if and when awarded.

	Development Agency	Partner <name of consortium partner 1>	Partner <name of consortium partner 2>
Name of Organization			
Signature (Authorized Signatory)			
Name of Signatory			
Designation of Signatory			
Seal of Organization			
Place			
Date			

The information above is correct to the best of my knowledge. Yes

I accept the [Terms and Conditions](#) Yes



Project Proposal Form

PART – B: FINANCIAL FORM

Project Name:

Proposal Number: To be provided by the Industry

Price Bid

⚠ Please detach this section and submit as Price Bid separately.

Subsection 1 : Contributions

• Lead DA Contribution

--Enter Amount (in INR
Lakhs)--

• Lead DA contribution (in %)

--Enter Value--

• CP Contribution Amount

--Enter Amount (in INR
Lakhs)--

• CP Contribution (in %)

--Enter Value--

• AP Contribution Amount

--Enter Amount (in INR
Lakhs)--

• AP Contribution (in %)

--Enter Value--

• Incubator (Academia) contribution (in %)

--Enter Value--

Note: Must be < 20%



• **Total Funding Sought from DRDO**

-Amount (INR Lakhs)-

Percent of contribution (in %)

• **All the funding sought from DRDO for the project is inclusive of GST.**

I AGREE

Subsection 2: Cost head Expenses Details



- A. Academia - Not more than 40% of total cost
- B. Contingency - Not more than 3% of total cost
- C. Overhead - Not more than 10% of total cost
- D. Incubator - Not more than 20% of total cost

S.no	Cost Head	Amount	Justification	Percentage Contribution	Milestone
	Click here				Select Milestone # <Check Boxes: 1-4>

ADD NEW

CLOSE

Subsection 3: Financial Milestones

S. No	Milestone	Cost Development	Cost DA	DRDO Funding (in %)
	<auto fill Milestone No.>	<numeric input>	<numeric input>	<numeric input>

ADD NEW

CLOSE

**NOTE:**

1. The Authorized Representative for the Start-up is required to sign and seal all the pages.
2. The Time Period for Submission of the Proposal Form is 30 days from the date of issue.
3. **Price Bid to be submitted in Part B only. In case, Part-A contains Price Bid, the proposal will be summarily rejected.**
4. The SOP and Terms and Conditions and other details as listed on TDF Website are applicable for the scheme.
5. All sections of Proposal Form are mandatory

Evaluation criteria for EoIs (DPRs) in r/o NASCENT STARTUPS/STARTUPS

S.N.	BROAD CATEGORY OF EVALUATION	
	(1) Design Capability (60)	
1.	PI & TEAM; technical capability/Qualification/Quality of the Team (Startups/Incubator)	20
2.	Proposed configuration / Novelty	15
3.	Approach to meet functionalities	10
4.	Indigenous design capability in subject field (% Indigenous Content in the proposed technology development)	12
5.	Total No of patents translated into product in the subject field and total No proposed to be utilized for the project	03
	Total	60
	(2) Fabrication and Manufacturing Capability(35)	
6.	Indigenous manufacturing capability (plant and machinery) (with Startups/Incubator Partner)	10
7.	Potential to meet defence needs/innovative/Unique Solution as per the Project requirement	10
8.	Presentation /Potential Impact/Overall Assessment	07
9.	Inter-operability across the Services/Potential for dual use/ Export Potential	05
10.	Execution of projects in India / abroad	03
	Total	35
	(3) Nature of DA (05)	
11.	Nature of the Company/Startups	3
12.	Nature of the Incubator	2
	Total	5
	Grand Total	100