Request for Proposal Package – Safe Lithium-Ion Battery Development

1) Summary

Naval Nuclear Laboratory (NNL), operated by Fluor Marine Propulsion LLC (FMP) for the Department of Energy, is accepting proposals to develop a lithium-ion battery as a backup energy storage system capable of providing 2.4 MW*hrs of usable energy throughout life. For the design of the battery system to be considered successful, it must demonstrate balance of the objectives of continuity of power, not exceeding design limits, and integrating a sufficiently robust safety posture such that the risk to the host asset is reduced to an acceptably low level. The battery system shall have the capability and reliability to maintain operations both during and after a "credible casualty" of the battery system. Credible casualties and other critical details of the system are outlined in the requirements table below. The goal of this work scope is to develop a battery system that meets the energy/power demands of the system and fits within the specified volume while maintaining a sufficient safety posture. This RFP is for development of a prototype only, and additional unit purchase are not guaranteed at the present time.

The requested submission deadline for proposals to this RFP is April 7, 2025. Funding decision will be made by October 2025. As part of this RFP solicitation, FMP will hold an information session to solicit any questions and to provide feedback about the RFP as needed.

1. Question and Answer Session
    a. Date and Time: February 27, between 1100 and 1200EST
    b. Teams Info:
       Call in: 332-206-0599
       Code: 560464139#

2) Design Approach

It is desired that the Li-ion battery prototype design should reflect one of two distinct styles or a combination of design styles, as explained below.

First, there are benefits to investigating existing battery module product lines. Starting from an established battery design and modifying aspects as needed to meet the FMP safety objective can leverage existing industry experience and manufacturing resources. Therefore, FMP seeks proposals that are expanded from existing systems, with the potential to adapt to the FMP requirements.

Second, there are benefits to designing a battery system from the ground up to meet the FMP objectives and requirements, rather than using a battery system that was designed with other priorities in mind. The safety requirements for this design effort will likely be more stringent than the target safety posture for batteries in the electric vehicle market. Therefore, FMP wants to solicit battery system proposals from organizations that are willing to partner on design development and potentially initiate a new battery system design. Note that this approach does not preclude the use of modules and packs that may already exist in industry, but it acknowledges that significant changes to an existing system's architecture may be necessary to achieve a sufficient safety posture.

3) Requirements Table

The following requirements in Table 1 shall be included in the design.

Table 1: Battery System Requirements Table

ID	Requirement	Description
1.01	Battery Management and Architecture	Shall have a battery management system that enables continuous operation and protection of the system while a portion of the system is impacted by a casualty of the battery or undergoing maintenance.
1.02	Usable Energy Storage Capacity	Shall be scalable up to 2.4MWh usable (End of Life capacity) Beginning-of-life battery life needs to account for operating cycles and the expected calendar life of the system, such that the baseline capacity remains at the end of the specified service life.
1.03	Power Capability	Shall be able to operate continuously at a 1C rate.
1.04	Emergency Operation	Shall be able to operate continuously as defined in the power capability requirements, even during a credible casualty to the battery.
1.05	Maximum volume	Shall fit within the volume constraints of 21' long x 10' wide x 6.5' tall. • Note that personnel shall be able to enter this volume and perform maintenance on the battery system. • Access to battery is not available from the exterior of this volume, except for a few entry points for personnel to enter.
1.06	Maximum, Minimum Voltage	Acceptable voltage interface range: 210-355 VDC, Shall be scalable up to 1000 VDC Unregulated • Module voltage should be less than or equal to 50V for electrical safety requirements ○ 30 V is preferred, but should not drive significant changes to the overall design
1.07	Safety Manual	Shall be designed to meet NAVSEA S9310-AQ-SAF-010, Revision 3.

1.08	Propagation	Shall be designed to have passive propagation resistance at the cell level. A single instance of thermal runaway across multiple cells shall be ensured not to occur; if a cell does fail due to thermal runaway, it must not lead to a cascading failure.
1.09	Service Life	Shall have a goal of greater than 8 years, and greater than 1000 cycles of service life.
1.10	Charging	Shall be able to self-charge using the host asset's power bus
1.11	String/Module Isolation	Shall provide the ability to connect and disconnect an appropriately sized portion of the battery to the main system without impacting the main system's ability to meet the operational requirements.
1.12	Module Considerations	Maximum dimensions of largest battery module is 36" x 24" x 22". Maximum weight of any single battery module is 500 lbs. Voltage for a single module shall be 50V or less.
1.13	Operating temperature range	Minimum = 50°F Maximum = 122°F Self-heating effects during charge/discharge shall be taken into account.
1.14	Thermal Management Interface	Different approaches to thermal management are acceptable. However, the chosen thermal management design should not be relied upon during casualty scenarios to the host asset in which the thermal management system may not be available. Instead, active thermal management systems should be used to enhance lifetime. Additionally, the limiting power requirements may occur when active cooling is not available.
1.15	Shock and Vibration	Shall meet the shock and vibration requirements of MIL-S-901 Grade A specifications.

1.16	Continuity of Power / Protection Posture	In order for the design of the battery system to be considered successful, it must balance the objectives of continuity of power, not exceeding design limits, and integrating a sufficiently robust safety posture such that the risk to the host asset is reduced to an acceptably low level. The battery system shall have capability to maintain operations both during and after a "credible casualty". The threshold for a credible casualty shall also be justified and documented.
1.17	Credible Casualty Considerations	The battery design shall not allow defined design limits of battery cells (e.g., voltage, current, temperature, power) to be exceeded for any credible casualty or defined use of the battery. Credible casualties consist of the following scenarios: 1. An initiating event, and 2. The most limiting subsequent single failure in one of the systems relied upon to provide battery protection, and 3. An individual cell independently entering thermal runaway in the most conservative location within the battery architecture
1.18	Safety Posture	The goal of a safe battery is to minimize the impact of the casualty in the event that a design limit is exceeded during a casualty more severe than the credible casualty described in 1.17. The battery system shall mitigate the consequences of casualties more severe than 1.17 such that the casualty poses an acceptably low risk to the host asset and its occupants. The battery system may incur damage during this casualty, and it is not expected that portions or all of the battery would remain operable.

1.19	Hazards/consequence of improper operation	The battery concept, on a module-basis or a system-basis must contain all gases as well as all solids/liquids during a potential casualty event (e.g. thermal runaway), while maintaining pressure (i.e. no rupture and internal pressure less than 50% of venting mechanism if available) and temperature (i.e. less than 100°C) requirements. In a single event of a loss, or the isolation of a module/string due to protective features, the requirements for power and energy of the system must still be achieved. Any other hazards/consequences and mitigation means should be detailed by the vendor.
1.20	Gas Management	A strategy for the handling of both gas and effluent, during both normal operations and casualties, shall be determined for scenarios where direct venting to external atmosphere is not achievable. Potential aspects of the strategy may include containment, conversion, or transfer of the gas to a separate container.
1.21	Containment	Shall have some form of containment for ejecta and associated combustible gases which shall enclose the battery system. Containment is the final barrier against the release of the material of concern in the event of an accident. The containment structure shall therefore be capable of withstanding, without loss of function, the pressure and temperature conditions resulting from a postulated casualty, such as a propagation event.
1.22	Fire Suppression	Shall incorporate engineered safety features which suppress, extinguish, or otherwise mitigate the consequence of a casualty that can result in a fire.

1.23	Common Mode Failures – Fault Tolerance	Potentially identify the separation of planes of electrical, sensing, thermal management, etc. for the purposes of minimizing the impact of thermal management system failures. By separating each key battery functionality onto different planer directions of a module/pack/cabinet, the risk decreases that a failure in 1 plane (e.g. water leak) impacts another plane's function (e.g. electrical connections.
1.24	Redundancy and Coincidence – Engineering Practices	Safe operation of the battery shall be considered through the use of design techniques such as redundancy, independence, coincidence, channel separation, and reduced operating capabilities with regard to all protection and safety systems.
1.25	Important Controls	Where appropriate, backup local manual controls shall be provided to permit continued operation of the battery when normal, potentially automatic, controls fail under casualty conditions. When operator action is required for casualty operation, backup local controls are mandatory. It is not necessary that all battery and protection system interlocks, components and system protection features, and all normal system operating modes be available in local manual control.
1.26	Demonstration Documentation and Actions	1. Shall provide proof of margin and capability during operation and credible causalities. 2. Shall provide quantified system behavior for all agreed safety scenarios. 3. Shall perform sufficient testing to prove that the design can satisfactorily meet battery performance and shock requirements.
1.27	Maintainability	Shall provide a discussion of the required actions and schedule for maintenance, inspection, and testing. This maintenance schedule serves a dual purpose, both in repairing the battery system and in confirming performance will be as expected per the design documentation. It is desirable to keep maintenance burden as low as reasonably achievable.

4) Notional Work Structure and Deliverables

This section is provided for information and presents the notional content and deliverables that a contracted project could entail for the selected vendor. The contracted effort will take a phased approach, which will trigger different actions and modes of work. Submitted proposals should provide cost estimates for each discrete phase of work.

- Contract Placement
  - Milestone 0: A work plan, including high level schedule, for this scope of work for FMP approval shall be created within four weeks of placement of tasking. A meeting should be held with FMP within this timeframe to discuss any questions or thoughts regarding the pending work plan.
- Phase 1: Conceptual Design (potentially multiple)
  - Scope: Evaluate conceptual designs to meet customer requirements.
  - Milestone 1: Down select for detailed design
- Phase 2: Detailed Design
  - Scope: Iteratively develop conceptual design into a detailed design. Evaluate the design against requirements during various operational and casualty scenarios.
  - Milestone 2: Interim design report
- Phase 3: Manufacture and Test Phase
  - Scope: Manufacture and test a representative portion of the battery system as necessary to validate the assumptions made during the development effort and to confirm satisfactory performance of the battery relative to the requirements.
  - Milestone 3: Final design report, final test report, final delivered hardware

Periodic meetings will be held to discuss progress and provide guidance, at a frequency agreed upon by FMP and the vendor. Nominally, these meetings could take place monthly. Additionally, a longer design review meeting will be held, in-person, at the end of each phase, during which FMP will have the opportunity to comment and discuss the results. After a satisfactory adjudication of any comments and FMP acceptance of the current state of the project, FMP will make the determination to proceed with the project and authorize funding for the next phase of work.

5) Expected Deliverables

The outcome of this effort will comprise of (1) a final design report that defines the characteristics of the battery system and demonstrates how the design will meet the requirements during various operational and casualty scenarios, (2) an analysis and test report identifying the performance of a representative portion of the battery system, as agreed to by FMP, and (3) a representative number of strings and modules to be delivered to FMP for external testing along with a commensurate level of BMS. The amount of hardware delivered to FMP will be agreed upon by the vendor and FMP during the development effort. The following documentation and hardware will be requested during the contracted project.

- Modules and commensurate level of BMS for testing and demonstration
- Interface equipment and/or emulators needed for module level testing of battery and BMS
- Design report detailing performance and the strategy and limitations of scalability (MWh, Voltage, Current, Power)
- Vendor test procedures and test reports for any vendor performed testing showing compliance with the requirements
- Conceptual designs for a full scale system
- Report of required support systems external to the design volume
- Other deliverable deemed necessary and agreed to between FMP and the Vendor

6) Point of Contact for Proposal Submissions and Questions

Christopher M. Smith

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Fluor Marine Propulsion, LLC

Supplier Data Sheet - Representations

P-302
03/2022

ALL FIELDS ARE REQUIRED AND MUST BE COMPLETE TO PROCESS

If the information on this form changes, please submit an updated form.

Full Company Name:		
*If a division, subsidiary or affiliate of another company, identify related Company information:		
DUNs No.*:	SAM.gov UEI:	Taxpayer ID or Social Security No.:
Sales/Contract Office Street Address:		
City:	State:	9 Digit Zip: -
Country:	County:	Congressional District No.:
Contact:	Phone:	Fax:
Website:	E-Mail:	

Supplier Type

- ☐ Supplier
- ☐ Education/Non-Profit
- ☐ Government
- ☐ Other:

Business Type

- ☐ Corporation
- ☐ Partnership
- ☐ Individual/Sole Proprietor
- ☐ Other:

North American Industrial Classification System**

NAICS Code	NAICS Industry Title	Size Standard

North American Industrial Classification System (NAICS) codes and descriptions applicable to the products/services offered (see www.census.gov/epcd/www/naics.html). List Primary NAICS code first. If additional codes apply, provide information on an attached sheet.

Annual Revenue***

Number of Employees***

*To obtain a DUNs number, visit http://fedgov.dnb.com/

**To qualify as a Small Business, your business must not exceed the size standard for the NAICS code FMP best believes describes the product/service being acquired.

***Required if business entity certifies as a Small Business per 13 CFR 121

Socioeconomic Information

☐ Large Business

If a Large Business, check the following if applicable:

- ☐ Alaska Native Corporations (ANCs) and Indian Tribes that are not small businesses

OR

☐ Small Business (per 13 CFR 121)**

If a Small Business, check any of the following that apply:

- ☐ Woman-Owned
- ☐ Economically Disadvantaged Woman Owned
- ☐ Women-Owned Small Business eligible under WOSB Program
- ☐ Small Disadvantaged Business
  - ☐ Aleut Owned
  - ☐ Asian-Pacific American Owned
  - ☐ American Indian Owned
  - ☐ Black American Owned
  - ☐ Eskimo Owned
  - ☐ Hispanic American Owned
  - ☐ Native American Owned
  - ☐ Subcontinent Asian-American Owned
- ☐ HUBZone—SBA Certified (per FAR 52.219-4a)
- ☐ Veteran-Owned
- ☐ Service Disabled Veteran-Owned
- ☐ Historically Black College & University (HBCU)
- ☐ Alaska Native Corporations (ANCs) Owned
- ☐ Indian Tribe (Federally Recognized) Owned
- ☐ Tribally Owned Firm
- ☐ 8(a) Business Development Program Certified
- ☐ Native Hawaiian Organization Owned Firm

Supplier Representative Certification For the penalties for false representation, see FAR 52.219-1(d)(2) and 52.219-9(e)(5)	
Name:	Title:
Signature:	Date:

Misrepresentations of business status as a small, small disadvantaged, small women-owned, small veteran-owned (including service disabled), and HUBZone small business concerns for the purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the requesting Contractor's subcontracting plan, without remedy, can result in severe penalties.

Under 15 U.S.C. 645 (d), any person who misrepresents a firm's status in these same categories in order to obtain a contract to be awarded under the preference programs established pursuant to section 8(a), 8(d), 9 or 15 of the Small Business Act or any other provision of the Federal law that specifically references section 8(d) for a definition of program eligibility, shall: (i) Be punished by imposition of fine, imprisonment, or both; (ii) Be subject to administrative remedies, including suspension and debarment; and (iii) Be ineligible for participation in programs conducted under the authority of the act.