INVITATION FOR RESEARCH PROPOSAL UNDER THE "R&D SCHEMES OF MOP BEING IMPLEMENTED THROUGH CPRI"

The "R&D schemes of MoP being implemented through CPRI" is being coordinating by CPRI. The scheme basically aims to provide funds for carrying out applied research in power sector including coming up with new innovations for the future Indian Power System.

In the present call, proposals are invited from Academia, Industry and R&D Institutions etc. on some of the identified topic of research. The expected outcome is a product or process at TRL 5 and above. The topics for research is enclosed as **Annexure I.**

Proposals along with technical and financial particulars may be submitted in the prescribed format (available in the CPRI website) under the NPP scheme to:

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Last date of submission for the proposal is: 24th August 2023

Annexure I

THE RESEARCH TOPICS FOR SUBMITTING THE PROPOSAL IS AS FOLLOWS:

Sl. No.	R&D Topic	Brief description of the R&D topic	Outcome
1.	Indigenous design and development of alternate Battery Energy Storage technologies	Alternative chemistry batteries have gained attention for their potential use in various applications as alternative to li-ion batteries, including low-speed electric vehicles, residential and industrial energy storage, data centres, 5G base stations, renewable energy grid storage, and smart grids. Indigenous design and development of alternate battery energy storage technologies for large-scale applications is an important field of research that is gaining increasing attention in recent years. With the growth of renewable energy sources, such as wind and solar power, there is a need for high capacity energy storage systems that can effectively store and supply energy during periods of low energy generation and store energy in times of excess generation. Thus it is desired that alternative chemistry based solar energy storage for micro-grid system may be designed and developed, which will utilize alternative chemistry batteries as the primary energy storage component. The battery may be indigenously developed and fabricated. This micro-grid system would integrate grid electricity, solar cells, and charging facilities, and would be capable of connecting to the public grid as needed.	•Development and demonstration of a solar micro-grid with alternate chemistry energy storage device as the primary storage. •Identify and select the most promising alternative chemistry battery technologies for use in the micro-grid system based on their performance, cost, and safety considerations. •Develop and optimize the battery chemistry and electrode materials for the chosen battery technology to achieve good energy density, long cycle life, and good safety performance. •Design and optimize the micro-grid system architecture to achieve efficient energy management and control, as well as seamless integration with the public grid. •Develop a control and management system for the micro-grid system that can handle the dynamic and fluctuating energy demand and supply from the grid, solar cells, and the alternative chemistry batteries. •Conduct extensive testing and evaluation of the alternative chemistry batteries and the micro-grid system in real-world conditions to assess their performance, reliability, and safety. •Investigate the potential of indigenously developing and fabricating the alternative chemistry batteries for cost-effectiveness and sustainable production. •Conduct a techno-economic analysis of the micro-grid system to evaluate its economic viability and potential impact on the energy market and grid infrastructure. •Explore the regulatory and policy implications of implementing the micro-grid system, including standards for safety and performance, grid interconnection regulations, and incentive

			mechanisms for promoting the deployment of renewable energy micro-grids.
2.	Indigenous design, development, and demonstration of Electric Vehicle Supply Equipment (EVSE) (min 50kW capacity) which is cost effective and efficient.	The development of Electric Vehicle Supply Equipment (EVSE) has been a key focus in promoting e-mobility. EVSE includes charging stations, cables, and other components necessary for charging electric vehicles. One of the major challenges in promoting e-mobility is the high cost of EVSE, which can deter potential buyers from investing in electric vehicles. Research in the field of Electric Vehicle Supply Equipment (EVSE) is critical to support the deployment and adoption of Electric Vehicles in India. Some of the key research areas for EVSE include the improvement of charging technology, such as the development of fast-charging solutions and wireless charging systems. A fast EV charger with minimum of 50kW capacity and compatible with the CCS protocol. Additionally, research is needed on the design and optimization of charging infrastructure to ensure that it is reliable, efficient, and cost-effective. Another critical area of research is the integration of EVSE with renewable energy sources, such as solar and wind power, to reduce the carbon footprint of electric vehicles. Furthermore, research on battery technology is essential to improve the efficiency of charging and increase the range of electric vehicles. Finally, research is needed for innovative design of charging infrastructure having smaller footprint which can help to promote the widespread adoption of electric vehicles. Overall, these research areas are critical to advancing the development of EVSE and promoting the adoption of electric vehicles as a clean, sustainable mode of transportation.	i.Development and demonstration of a compact and reliable Electric Vehicle Supply Equipment (wired/wireless) which is cost effective and manufactured with ease in India. ii.The minimum capacity of the EV charger is expected to be 50kW and is desired to be CCS complied with fast charging capability. iii.The Electric Vehicle Supply Equipment (EVSE) should: a.Comply with the market accepted codes and standards b.Have target specifications equal or better than the products available in the market c.Capable of withstanding the harsh climatic conditions across India iv.Patent filing and research publication
3.	Technologies for more accurate Load and Renewable generation forecasting	Effective load and renewable generation forecasting requires focussed research to improve the accuracy and reliability of the models used. One key area of research is the development of advanced machine learning techniques that can identify patterns and correlations in large and complex data sets. Machine learning algorithms, for example ANN, CNN, RNN, Transformer-NN can be trained on	1.Develop more accurate and reliable load and renewable generation forecasting models that take into account multiple variables such as weather conditions, and grid conditions. 2.Investigate the effectiveness of machine learning algorithms for load and renewable generation forecasting, and develop new

		historical data to learn how different variables influence load and renewable generation, allowing for more accurate and granular predictions. Other areas of research include the integration of real-time sensor data into forecasting models, the use of advanced weather modeling to predict renewable energy output, and the development of hybrid models that combine multiple forecasting techniques. Additionally, research is needed to better understand the behaviour of renewable energy sources, including the impact of weather conditions, changes in demand, and grid conditions on output.	algorithms that can improve the accuracy of predictions. 3.Explore the integration of real-time sensor data into forecasting models, and investigate the impact of different types of sensor data on the accuracy of predictions. 4.Develop effective hybrid models that combine multiple forecasting techniques, such as machine learning algorithms and weather modeling, reinforcement learning, to improve the accuracy of predictions.
4.	Process for production of synthetic graphite from Agro waste	Graphite is a valuable resource used in a variety of industrial applications, including batteries, lubricants, and electronics. Traditionally, graphite has been extracted from natural deposits, but as these sources are becoming depleted and alternative methods of extraction is required to be explored. One promising approach is the extraction of graphite from agro waste, such as wheat straw, maize and sugarcane bagasse. These materials contain high levels of hemi-cellulose which can be converted to carbon, and then into graphite through a series of chemical processes. This approach not only provides a sustainable source of graphite, but also offers a solution for the disposal of agricultural waste. Under this call for proposal the researchers are desired to explore and develop efficient and cost-effective methods for obtaining graphite from agricultural waste. The focus of the research should be on developing new technologies or improving existing ones to extract and purify graphite from agro waste. Research is ongoing in this area, and the development of efficient and cost-effective methods of extraction could have significant implications for the graphite industry.	•Identification and characterization of suitable agro waste materials for graphite extraction. •Optimization of the extraction process to maximize the yield of graphite. •Purification of the extracted graphite to meet industry standards. •Techno-economic feasibility analysis of the proposed extraction process. •Environmental impact assessment of the proposed extraction process.
5.	Indigenous design, development, and demonstration of 5kW room temperature sodium sulphur battery	Currently, lithium-ion batteries hold a dominant position among battery technologies due to their reliable efficiency, safety, and relatively high energy density. However, as the use of various electronic products, such as electric vehicles, becomes more widespread, the cost of lithium resources is rising. Additionally, emerging applications, including large-scale grids,	•Develop a detailed design and specification for the 5KW sodium-sulphur battery system, including the battery modules, control electronics, and auxiliary equipment. •Designing and optimizing the cell configuration to achieve higher electrochemical performance and enhanced safety.

		typically require battery technologies with lower costs and higher energy density. Therefore, research is required to find low cost and reliable non-Lithium based battery systems that can meet these criteria. One of the most promising options for low-cost and high-energy-density storage systems is room-temperature sodium-sulphur batteries, which offer several advantages due to the abundance of raw materials and high theoretical capacity of both sodium and sulphur. Under this call proposals on development of an efficient and cost-effective 5kW sodium sulphur battery that can store renewable energy, especially for off-grid applications is desired. The proposed research should focus on the following areas: Material development: Developing high-performance materials for the battery components, including the electrodes, electrolyte, and separators. Cell design: Designing and optimizing the cell configuration to achieve higher electrochemical performance and enhanced safety. Manufacturing process: Developing a scalable and cost-effective manufacturing process for the battery cells. Testing and validation: Conducting extensive testing and validation to ensure the battery's reliability and performance.	•Source or fabricate the necessary components for the battery system and assemble them into a functional prototype. •Conduct a comprehensive safety analysis of the battery system to identify potential hazards and mitigate risks, including fire, explosion, and chemical release. •Conduct a series of tests to evaluate the electrochemical performance and operational characteristics of the battery system, including efficiency, capacity, power density, and cycle life. •Develop and implement a control and monitoring system for the battery system to ensure safe and reliable operation under a range of operating conditions. •Conduct a cost-benefit analysis of the sodium-sulphur battery system compared to conventional energy storage technologies, including battery storage, pumped hydro, and thermal storage.