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# PURPOSE:

The purpose of this Standard Operating Procedure (SOP) is to establish a structured, consistent, and cross-functional approach for the development of new lithium-ion cell products from concept to production readiness. It outlines the key activities, responsibilities, documentation, frameworks, and review gates required to ensure the new cell designs meet customer requirements, regulatory standards, technical specifications, cost targets, and performance benchmarks.

# SCOPE:

This SOP aims to:

* Ensure a systematic and phase-gated NPD framework to ensure disciplined product maturation and decision-making.

1. Gate 0: Opportunity Identification & Strategic Planning
2. Gate 1: Cell Design Validation
3. Gate 2: Prototype Cell Development & Validation
4. Gate 3: Pre-Pilot Development (Sample-A)
5. Gate 4: Pilot Production & Customer Sampling (Sample-B)
6. Gate 5: Gigafactory Readiness & SOP Transition
7. Gate 6: Start of Production (SOP)

* Accelerate time-to-market while minimizing risks by enabling early identification and mitigation of issues related to technical feasibility, design maturity, manufacturability, material availability, supply chain readiness, cost competitiveness, safety, and scale-up capability
* Ensure that product development aligns with

## Gate-0: Opportunity Identification & Strategic Planning

### Objectives and Scope:

* Define the product vision, target markets (2W/3W/ESS/4W/CV), chemistry (LFP/NMC), and form factors.
* Assess customer requirements and market trends to establish the feasibility of the new cell.
* Conduct competitor benchmarking and high-level risk assessment (technology, market, IP).
* Prepare high-level budget planning (CapEx & OpEx) and get management approval for moving to the concept stage.

### Activities and Tasks:

1. Market and Customer Analysis:
   1. Sales and Program team needs to consolidate requests and conduct market research to identify emerging trends and customer needs. High level expectations and requirements can be listed in either cell SOR or pack SOR.
   2. R&D team needs to assess the requirements and compare them with market trends. This can be done with help of Industry experts. They can help by doing a deep dive into what specifications are being developed by competitors and what changes are being made in the structure and chemistry.
   3. Prepare a feasibility report focusing on chemistry (LFP/NMC) and cell form factors. This should include topics like: Electrode formulation feasibility, level of complexity to develop, current and future supply chain capabilities to provide the required raw materials, How the proposed cell can affect the pack design, Energy density vs Cycle life vs safety trade-off analysis etc.
2. Business Case and ROI Analysis:
   1. A Business Case should be made by the Program team and Commercial team. This business case should include the following:
      1. CapEx and OpEx estimates
      2. Estimate of TAM, SAM, and SOM
      3. If possible, it should highlight price expectations of the market
      4. Estimate the return on investment based on target application areas (2W, 3W, ESS, 4W, CV)
      5. Perform a top-down analysis of potential profitability and market penetration

Note: Tools like BatPac and ProZell Cost Model can help in cost modelling.

1. Risk Assessment and Budgeting:
   1. Identify risks related to reliability, warranty, and manufacturing.
   2. Prepare a preliminary risk matrix covering technological and operational challenges.
2. Simulation and Modeling:
   1. Conduct initial simulation of cell electrochemical performance (COMSOL, AutoLion or Battery Design Studio)
   2. Evaluate electrode formulation feasibility and thermodynamic modeling of various chemistries
   3. These activities can be done by taking collaborating with various development house. R&D team needs to evaluate the different development houses to partner with. The assessment should include: 1. Capability to carry out modelling, simulations, research activities 2. Capability to deliver prototype cell 3. Capability to carry out different physical, chemical and electrical test 4. Capability to deliver Sample A, Sample B.

### Roles and Responsibilities:

* Sales Team: Market analysis and customer requirement gathering.
* Cell R&D: Initial simulation, feasibility studies, and chemistry selection.
* Finance Team: Budget estimation and ROI analysis.
* Risk Management: Preliminary risk assessment.

### Deliverables and Documentation:

1. Product Concept Document
2. Feasibility Report
3. Business Case and ROI Estimation
4. Competitor Benchmarking Report
5. High-Level Budget Plan

### Quality and Risk Management:

* Conduct internal reviews and simulations to validate assumptions and feasibility.
* Ensure all inputs are verified and documented.
* Verification and Validation:
  + Perform a peer review of the feasibility report.
  + Validate the simulation models for accuracy and consistency.

### Gate Decision Criteria:

Approval based on feasibility, market opportunity, risk assessment, and budget alignment.

### Timeline:

0 - 2 months