Training - Battery Validation and Calibration Tests

EBACARA-EN-P

Face-to-face only

5 days
Asynchronous part to be completed before the face-to-face part

This training course aims to improve skills in battery validation and calibration testing during the design phase

Level
Skilled

Public
Engineers and technicians who wish to design, develop, model, simulate, or use storage systems integrated into electric and hybrid electric vehicles, considering the technical, economic, and industrial constraints of the transportation industry

Objectives
Attendees will be able to implement the following skills:

- Understand and explain the main mechanisms of battery aging
- Understand and be able to explain the integration of aging constraints in battery design,
- Understand and explain battery malfunction and safety tests
- Know the main battery validation and calibration tests,
- Know how to analyze battery performance tests.

Pedagogical & technical resources
Teaching activities, tutorials, and practical work.

Assessment of achievements

- Trainees are assessed throughout the training through practical application phases and interactions with the trainer
- A final on-the-spot evaluation may also be carried out at the end of the course and/or at the end of each module using tests designed to verify the learners' understanding and assimilation of the knowledge linked to the training objectives

Prerequisites
No prerequisites are necessary to follow this course.

Responsable
IFP Training instructors, with expertise in the field and trained in modern teaching methods adapted to the specific needs of learners from the professional world

Program

ASYNCHRONOUS PROGRAM TO BE COMPLETED BEFORE THE SYNCHRONOUS/IN-PERSON COURSE

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VIDEOS

Video 1 - Atoms Li-ions.
Video 2 - How batteries work.
Video 3 - Introduction to Lithium.
Video 4 - Composition of Li-ion batteries.
Video 5 - How Li-ion batteries work.

SYNCHRONOUS/IN-PERSON PROGRAM

BATTERY AGING MODELING AND CALIBRATION (LECTURES + PRACTICALS) 2 days

Aging of Li-ion cells.

- Aging mechanisms.
- Description of the main aging phenomena.

Modeling of Li-ion cell aging.

- Approaches.
- Aging models.
- Elements of thermodynamics, electrochemical kinetics, and mass transport.
- Model input parameters.

Tutorial work on battery design models.

- Applications: identifying limiting phenomena, cell design assistance, measurement of physical and geometric parameters.
- Other types of battery models: electrical analogy, simplified models, 3D cell model, resolved 3D microstructural models.

DYSFUNCTIONAL TESTS AND BATTERY SAFETY 1 day

Integration constraints.
Operational safety – safety concept.
Abuse tests.
Thermal propagation:

- Thermal propagation/runaway.
- Vibration.
- Thermal shock and cycling.
- Mechanical shocks.
- Mechanical integrity.
- Fire resistance.
- Protection against external short circuits.
- Overload protection.
- Overheating protection.
- Overcurrent protection.
- Low temperature protection.

Safety/abuse testing: in accordance with recognized standards (transport of hazardous materials – UN, ELLICERT, etc.):

- Mechanical (crushing, penetration, immersion, falling, etc.).
- Electrical (overload, over-discharge, short circuit, etc.).
- Thermal.

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PRACTICAL WORK: BASICS OF FUNCTIONAL CHARACTERIZATION TESTS FOR AN IN-VEHICLE APPLICATION — 1 day

Electrochemical characterization on educational test benches.
Familiarization with the main characterization and calibration tests required in the Integration Plan Vehicle (IPV), applied to demonstration electrochemical cells.

FUNCTIONAL PERFORMANCE TESTS (LECTURES/PRACTICALS) — 0.75 days

Drafting/monitoring of specifications and functional requirements for an automotive embedded application.
Analysis of electrical GMP specifications and drafting of battery specifications for supplier consultation: specifications. Performance - integration specifications - cost specifications, autonomy performance.
Identification of the main functional requirements of the specifications.
Breakdown of battery pack requirements into modules and cells.
Identification of the main functional characteristics required of the cells and the various characterizations and calibrations to be performed. Expected mission profiles.
Drafting of a simplified Vehicle Integration Plan.
Monitoring of IPV requirements. Analysis of various supplier feedback (4 to 6). Summary of results and justification of design choices based on performance, integration, and cost criteria.

EXAM — 0.25 day

Verification of acquired knowledge.

Sessions

Rueil-Malmaison - From 03/23/2026 to 03/27/2026 — **3040 €/HT**

To French entities : IFP Training is referenced to DataDock ; you may contact your OPCO about potential funding.
Please contact our disabled persons referent to check the accessibility of this training program : referent.handicap@ifptraining.com

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Training - Battery Manufacturing

EBAFAB-EN-P

Face-to-face only

5 days
Asynchronous part to be completed before the face-to-face part

This training course aims to improve skills in battery manufacturing

Level
Skilled

Public
Engineers and technicians who wish to design, develop, model, simulate or use storage systems integrated into electric and hybrid electric vehicles, taking into account the technical, economic and industrial constraints of the transport sector

Objectives
Attendees will be able to implement the following skills:

- Understand and explain the challenges of strategic battery materials,
- Understand and explain the main stages of battery manufacturing,
- Understand the digitization of battery manufacturing processes,
- Understand and explain the synthesis of active battery materials.

Pedagogical & technical resources
Teaching activities.

Assessment of achievements

- Trainees are assessed throughout the training through practical application phases and interactions with the trainer
- A final on-the-spot evaluation may also be carried out at the end of the course and/or at the end of each module using tests designed to verify the learners' understanding and assimilation of the knowledge linked to the training objectives

Prerequisites
No prerequisites are necessary to follow this course.

Responsable
IFP Training instructors, with expertise in the field and trained in modern teaching methods adapted to the specific needs of learners from the professional world

Program

ASYNCHRONOUS PROGRAM TO BE COMPLETED BEFORE THE SYNCHRONOUS/IN-PERSON COURSE

VIDEOS

Video 1 - Atoms Li-ions.
Video 2 - How batteries work.

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Video 3 - Introduction to Lithium.
Video 4 - Composition of Li-ion batteries.
Video 5 - How Li-ion batteries work.

SYNCHRONIZED/IN-PERSON PROGRAM

RAW MATERIALS. STRATEGIC MATERIALS — 0.5 day

Strategic materials and geopolitics.
Materials for batteries: graphite (anode), aluminum (cell casing, cathode, collectors), nickel (cathode), copper (collectors), manganese (cathode), cobalt (cathode), lithium (cathode), iron (cathode), steel (cell casing).
New families of disruptive active materials.
Lithium insertion materials.
Synthesis of lithium insertion materials.

CELL MANUFACTURING AND MODULE ASSEMBLY — 1.5 days

Overall process and environmental conditions.
Process.
Components introduced.
Focus on ATEX risks.
Steps.
Characteristics.
Things to keep in mind.
Mixing; Coating; Calendering and slitting; Cutting; Cell assembly; Electrolyte filling; SEI formation/degassing; Electrolyte filling; Cell assembly within the module.

DIGITALISATION OF BATTERY MANUFACTURING PROCESSES — 1 day

Part one:

- Definitions.
- Models.
- State of the art in physical process models.
- Focus on each step of the battery manufacturing process: mixing electrode inks, coating, drying, calendering.
- Generative methods for microstructured electrodes.
- Educational models for electrode manufacturing.

Part two:

- Electrolyte infiltration.
- Electrochemical performance.
- Cell optimization.
- Human/machine interfaces.

CHEMISTRY OF LI-ION CELL CORE MATERIALS AND DEVELOPMENTS — 1 day

Atomistics and electrochemistry: fundamentals and applications to the physical and chemical properties of materials used in Li-ion cell cores.
Synthesis of active materials: different approaches, key players, challenges, and avenues for improvement.
Comparison of the electrochemical and physicochemical properties of different active materials.
Tutorial: comparisons of mass/material balances for Li-ion batteries with different chemistries.

CORYS MANUFACTURING MODELING OF LI-ION CELLS (WORKSHOP) — 0.75 day

General principles of battery manufacturing processes.
Presentation and introduction to the simulator.
Presentation of the positions considered.

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Simulator-based scenario exercises.

EXAM **0.25 day**

Verification of acquired skills.

Sessions

Rueil-Malmaison - From 06/01/2026 to 06/05/2026 **3040 €/HT**

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Training - Modeling as an Aid to Battery Design

EBATMOD-EN-P

Face-to-face only

5 days
Asynchronous part to be completed before the face-to-face part

This training aims to improve learners' skills in modeling as a tool for designing cells and battery packs in the design phase

Level
Skilled

Public
Engineers and technicians who wish to design, develop, model, simulate or use storage systems integrated into electric and hybrid electric vehicles, considering the technical, economic and industrial constraints of the transport sector

Objectives
Attendees will be able to implement the following skills:

- Understand fundamental electrochemical laws,
- Understand Newman-type modeling methodologies,
- Understand and explain the design of a Li-ion cell based on a Newman-type model,
- Understand and explain the use of modeling in battery pack design,
- Be able to use the AMESIM tool.

Pedagogical & technical resources
Teaching activities and tutorials.

Assessment of achievements

- Trainees are assessed throughout the training through practical application phases and interactions with the trainer
- A final on-the-spot evaluation may also be carried out at the end of the course and/or at the end of each module using tests designed to verify the learners' understanding and assimilation of the knowledge linked to the training objectives

Prerequisites
No prerequisites are necessary to follow this course.

Responsable
IFP Training instructors, with expertise in the field and trained in modern teaching methods adapted to the specific needs of learners from the professional world

Program

ASYNCHRONOUS PROGRAM TO BE COMPLETED BEFORE THE SYNCHRONOUS/ FACE-TO-FACE COURSE

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VIDEOS

Video 1 - Atoms Li-ions.
Video 2 - How batteries work.
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Video 5 - How Li-ion batteries work.

SYNCHRONOUS/FACE-TO-FACE PROGRAM

ELECTROCHEMICAL MODELING AS AN AID TO LI-ION CELL DESIGN (LECTURES/PRACTICALS) — 3 days

Introduction:

- Main half-reactions, equilibrium potentials, and electrolyte stability window.
- Solid-state insertion and phase transition mechanisms.
- Volumetric electrodes and their characteristic parameters.
- Internal cell balancing and the unique characteristics of each technology.
- Introduction to the kinetic thermodynamics of batteries.
- Kinetic stages: double electric layer, ohmic drop, and crystallization overvoltage.
- Kinetic stage: charge transfer overvoltage.
- Kinetic stages: diffusion overvoltage.
- Battery cell in operation.
- Factors affecting battery performance.
- Battery design and voltage.

Electrochemical techniques:

- Galvanostatic cycling and measurement of capacity, coulombic efficiency, and energy efficiency.
- Constant current/constant voltage (CCCV) charging.
- Influence of current on galvanostatic charging and discharging.
- Measurement of pulse resistance and maximum power.
- Ragone diagrams.
- Peukert diagrams.
- Impedance spectroscopy.
- Measurements on half cells.
- Intermittent galvanostatic and potentiostatic measurements, incremental capacity curves.
- Battery durability and aging.
- Main aging phenomena.
- Effects of aging phenomena on cell performance (loss of capacity, power, reversible and irreversible self-discharge).
- Cell aging tests.
- Analysis of aging data using performance models (behavioral, electrochemical, etc.). Contribution of postmortem analyses.
- Aging models (empirical, physical, etc.).

Electrochemical modeling:

- Elements of thermodynamics, electrochemical kinetics, and mass transport.

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- Presentation of the electrode/separator/electrode+ (Li-ion) stack model.
- Model input parameters.
- Applications: identifying limiting phenomena, cell design assistance, measurement of physical and geometric parameters.
- Other types of battery models: electrical analogy, simplified models, 3D cell model, resolved 3D microstructural models.

Tutorials:

- Tutorial analysis of a Li-ion cell design (jelly roll thickness, percolating carbon grain size, porosity of active materials, etc.) based on a Newman model.

Electrochemical modeling:

- Elements of thermodynamics, electrochemical kinetics, and mass transport.
- Presentation of the electrode/separator/electrode+ (Li-ion) stack model.
- Model input parameters.
- Applications: identifying limiting phenomena, cell design assistance, measurement of physical and geometric parameters.
- Other types of battery models: electrical analogy, simplified models, 3D cell model, resolved 3D microstructural models.

AMESIM MODELING AS AN AID TO PACK SYSTEM DESIGN (LECTURES + WORKSHOPS) — 1,75 days

Presentation of Amesim - Tutorials on examples of battery applications for electric traction:

- Introduction to Simcenter Amesim and battery modeling - Practical.
- Identification of battery requirements - Practical.
- Creation of a cell and pack model that meets these requirements.
- Creation of a battery thermal management model.
- Impact of battery module design during thermal runaway.
- Calibration of the aging model and exploitation.

REVIEW — 0.25 day

Verification of acquired knowledge.

Sessions

Rueil-Malmaison - From 03/09/2026 to 03/13/2026 — **3040 €/HT**

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Training - M&A in the Energy World

FAE-EN-P | Face-to-face only | 2 days

Current developments in the energy sector are expected to lead to a new wave of mergers and acquisitions (M&A). Traditional Oil & Gas players will have to adapt (or continue to adapt for the most advanced) their business portfolio to the energy transition, and also to meet the challenges of the recent health crisis. The growth of Renewable Energy could also lead to consolidation amongst the first entrants as the sector matures. The objective of this training is to enable participants to successfully manage their acquisition operations and/or asset sales so that they can best position themselves for the future

Level

Knowledge

Public

Oil & Gas, Renewables companies' commercial, technical, financial managers and support functions staff involved in external growth operations. Public administration decision makers and personnel (industry, finance, energy, environment)

Objectives

Attendees will be able to implement the following skills:

- Lead/contribute to an M&A project through a structured process
- Evaluate assets to buy or sell using different methods (e.g.: multiples, discounted cash flows)

Pedagogical & technical resources

- Exercises
- Analysis of recent transactions
- Case studies: setting the maximum purchase price
- Case study: Critical review of a sale and purchase contract clauses
- Quiz

Assessment of achievements

- Trainees are assessed throughout the training through practical application phases and interactions with the trainer
- A final on-the-spot evaluation may also be carried out at the end of the course and/or at the end of each module using tests designed to verify the learners' understanding and assimilation of the knowledge linked to the training objectives

Prerequisites

No prerequisites are necessary to follow this course

Responsable

IFP Training instructors, with expertise in the field and trained in modern teaching methods adapted to the specific needs of learners from the professional world

Program

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KEY STEPS & RISKS OF M&A TRANSACTIONS — 0.2 day

The various types of transactions: assets/equity.
The main stages of an acquisition/divestment project.
M&A transactions risks: key success factors.
Key participants in the process.

DETERMINING THE PURCHASE/SALE PRICE — 1 day

The different valuation methods: multiples (comparable transactions, EBITDA, PER), discounted cash flows.
Discounted cash flow method and analysis criteria refresher (NPV, IRR, Payback time). Calculating the residual value/terminal value.
Defining the maximum purchase price (or minimum sale price) taking into account synergies/di-synergies and risks.
Price adjustment options to manage uncertainties/close valuation gaps between buyer and seller.
Taking into account debt.

DUE DILIGENCE & DEAL STRUCTURING — 0.4 day

Preparing an information memorandum.
Risk management. The due diligence process and datarooms.
Choosing the legal and tax structure of the transaction.
Assessing the impact of competition laws.

NEGOTIATIONS & KEY CLAUSES OF SALE & PURCHASE AGREEMENTS — 0.4 day

Pros and cons of the various sale methods: auctions, negotiations.
Counterparties' assessment.
Conditions/ precedents.
Commitments and guarantees.
Completion adjustments.

Sessions

Rueil-Malmaison - From 09/08/2026 to 09/09/2026 — **1980 €/HT**

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Training - Economic and Financial Modelling of Renewable Energy Projects

MPER-EN-P | Face-to-face only | 3 days

This course provides a better understanding of the use of decision-making tools in the field of renewable energy projects and incorporate risk analysis in the economic & financial evaluation

Level

Skilled

Public

Economists, engineers and financial analysts concerned with decisions affecting medium and long-term cash flows, such as investment, disinvestment, acquisitions, who need to improve their understanding of the theory and practice of investment analysis in the renewable energy sector

Objectives

Attendees will be able to implement the following skills:

- To carry out investment profitability studies in renewable energy projects including all aspects of fiscal incentives, inflation, and financing up to the Levelized Cost Of Electricity (LCOE) evaluation
- To analyze the deterministic economic results and carry out sensitivity analysis
- To incorporate the risk and uncertainties in the economic evaluation of renewable projects

Pedagogical & technical resources

Case studies simulated on computers

Assessment of achievements

- Trainees are assessed throughout the training through practical application phases and interactions with the trainer
- A final on-the-spot evaluation may also be carried out at the end of the course and/or at the end of each module using tests designed to verify the learners' understanding and assimilation of the knowledge linked to the training objectives

Prerequisites

No prerequisites are necessary to follow this course

Responsable

IFP Training instructors, with expertise in the field and trained in modern teaching methods adapted to the specific needs of learners from the professional world

Program

ECONOMIC CRITERIA FOR DECISION MAKING — 1.5 days

Cost of capital and discount rate, value creation.
Economic criteria for project evaluation: net present value (NPV), internal rate of return (IRR), payback period, etc.
Methodology for assessing the global profitability of capital invested.
Impact of taxation and inflation on economic indicators.

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Choosing an investment program with a limited budget, scarcity cost of capital.
Case studies: solar photovoltaic & wind power plant projects

ECONOMIC COST ANALYSIS — 0.5 day

Accounting cost vs. economic cost. Total discounted cost, annual economic cost.
Unit economic cost analysis vs. Levelized cost of electricity (LCOE).
Optimal economic lifetime (average cost & marginal cost).
Cases studies: LCOE of power plants, definition of an optimal economic lifetime.

IMPACT OF FINANCING ON PROJECT ECONOMICS — 0.5 day

Financing of renewable energy projects (ring-fencing and SPV concept).
Project finance valuation for renewable energy projects.
Different financing plans and debt repayment.
Return on equity (IRR and NPV of equity) and financial leverage.
Determination of the optimal electricity tariff leading to project economics balance.
Case studies: Solar photovoltaic and wind farm projects with specific financing.

RISK ANALYSIS OF RENEWABLE ENERGY PROJECTS — 0.5 day

Overview of resource assessment in renewable projects (wind & solar).
Probabilistic distribution approach (statistical & seasonal analysis of production, P99, P90 & P50 statics).
Risk matrix, risk classification and strategies for risk mitigation.
Risk evaluation using break-even price and sensitivity analysis.
Risk analysis using spider and tornado diagram.

CASE STUDIES

Solar photovoltaic project.
Wind power plant project.
Equipment optimal economic lifetime.
Power plant project.

Sessions

Rueil-Malmaison - From 12/09/2026 to 12/11/2026 — **3380 €/HT**

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