€10+Billion battery supply contract won with no real prototype

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Emmanuel Leroy
EVP Industry Solutions

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The head of the whole program conducting the bidding process went out of his way to tell us that the mechanical simulation was an instrumental part in helping us get the design approved. We could not have done that without ESI. Our partnership with ESI is truly strategic in bringing our simulation capabilities to a global leading standard.

Matt Klein, Director Advanced R&D – Farasis Energy Europe GmbH

Automotive Presentations

Presentation Title:

- Battery design optimization by using virtual solutions and automatic simulation workflow

Presentation Main points:

- Battery safety simulation and design optimization
- Mechanical abuse: crush and swelling
- Automated modeling process

Dr. Weiran Jiang
Director, Simulation
& Advanced Modeling
Farasis

As the director of simulation and advanced modeling at Farasis Energy, Dr. Weiran Jiang is leading a global multi-functional team across Farasis sites in USA, Germany, and China, with expertise on CAE, CFD, thermal management, system optimization, and lifetime prediction. The focusing area of his team is using simulation and advanced virtual solutions to guide the development and facilitate the mass production of next generation Li-ion battery with higher energy density and better safety performance. Prior to joining Farasis Energy, he served at Ford Motor Company and Dassault System with his great passion in automotive industry and multidisciplinary simulation fields

Dr. Weiran Jiang received his B.S. degree in Mechanical Engineering from Shanghai Jiao Tong University, and his dual B.S. degree, two M.S. degrees, and Ph.D. degree from University of Michigan, Ann Arbor, respectively in Applied Math, Naval Architecture and Marine Engineering, and Mechanical Engineering

What are the main challenges when designing a safe battery?

Battery safety simulation

Background

- Electrification is becoming a rapid growing part and the future trend of automotive industry
- Battery is considered as the most important and challenging components in the development of electric vehicles

Mechanical abuse and battery safety

- The battery safety is of great importance in terms of crashworthiness in severe events (crash and crush) and durability over lifetime (cell swelling)

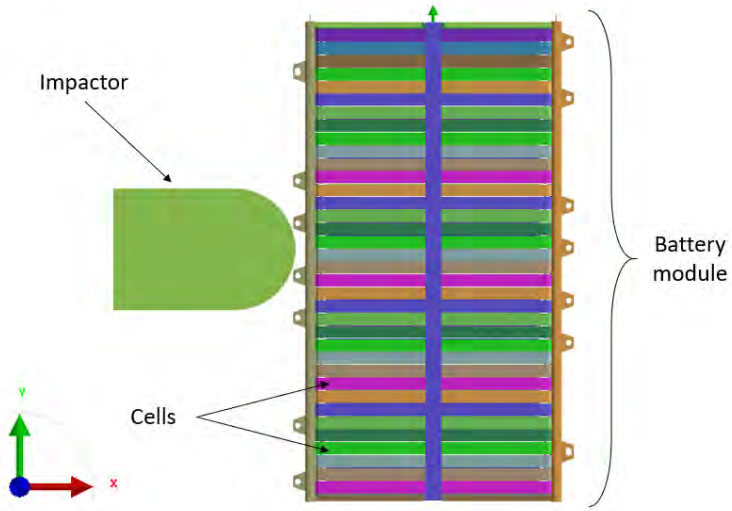
Prototype vs. virtual solution

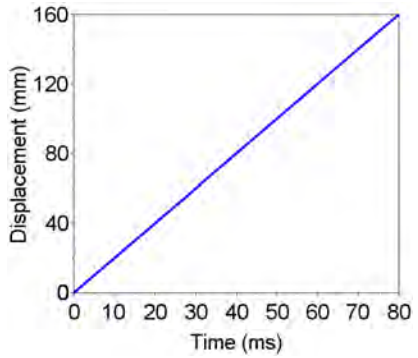
- Due to the extremely fast-growing demand, the traditional approaches can hardly meet the timeline expectation of new battery development
- Using modeling, simulation, and virtual solutions to facilitate the design on improving battery safety
- Farasis using ESI's VPS as the primary mechanical simulation tool for design and development of next generation battery with leading-edge safety level

Crush simulation and design optimization

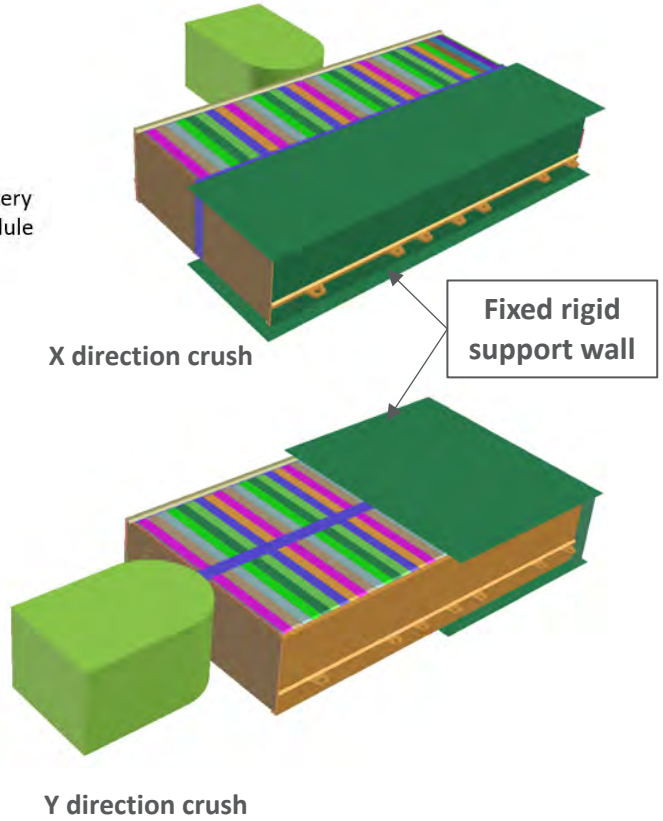
Battery module crush:

- Model setup and boundary condition

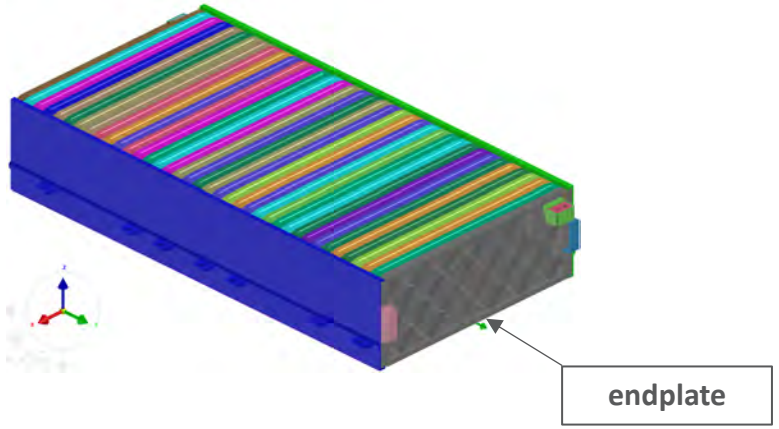




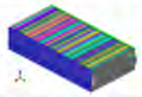
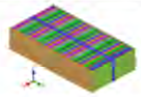
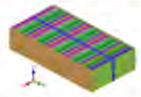
Constant crush speed applied by the impactor



*A generic battery module model is selected for this study



DOE and various design concepts are evaluated fast by using simulation on VPS

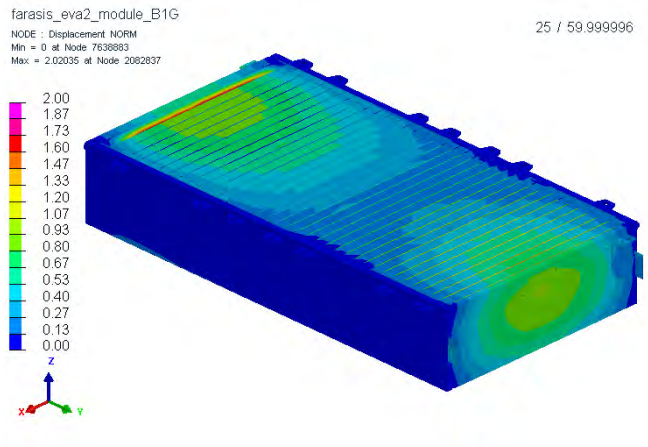
Version	Endplate (thickness and material)
v 1.0 	10 mm AL 6063 T6
v 2.0 	7 mm AL 6063 T6
v 2.1 	10 mm AL 6063 T6

In addition to crash, can you tell us more about other important virtual validations during the design of your batteries?

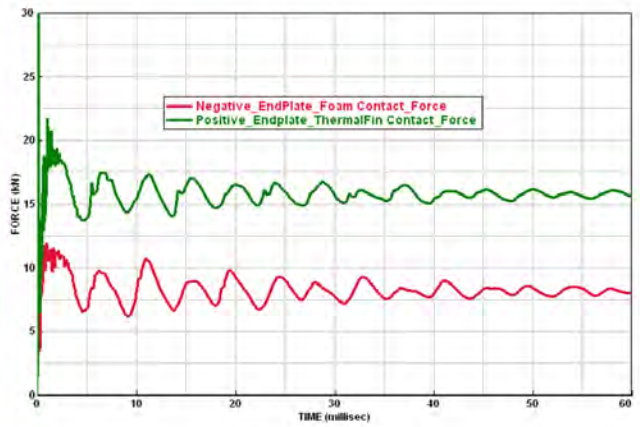
Swelling simulation and automation

Battery module swelling

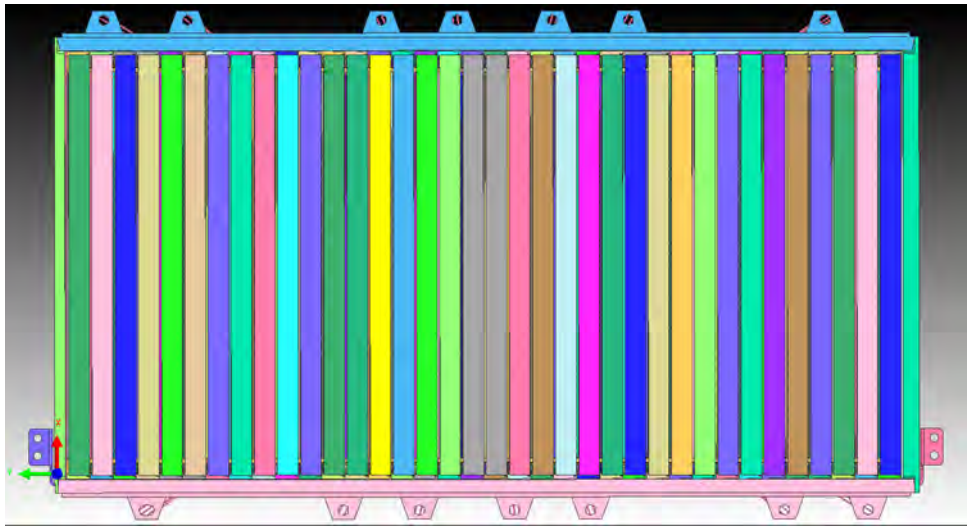
- Key parameters to be studied:
  - Cell form factor
  - Cell SOH -> cell thickness
  - Foam selection
- Objective:
  - Manage cell surface pressure over lifetime
  - Optimize module structure with enough strength

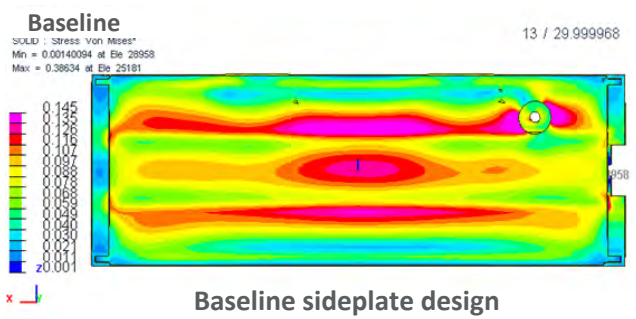


Cell swelling at 80% SOH

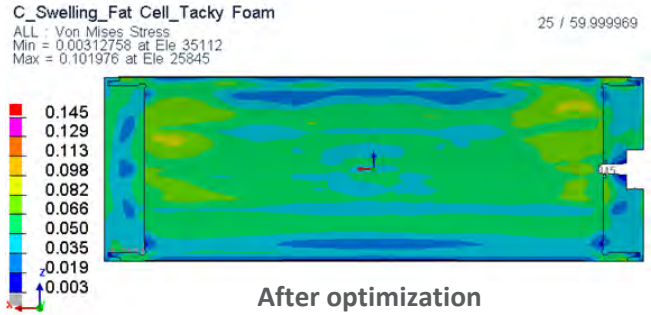


Reaction force on module sideplates





Baseline sideplate design



After optimization

Using simulation, various cell design and module design can be studied simultaneously to reach a good balance of battery performance and safety by extensively tuning the key parameters and fast screening suitable subcomponents.

Farasis Energy — Why did they win?

- No “drills”/ no “simulation toolbox”: instead outcome solutions, **co-created with ESI Group and an ecosystem of partners**.
- Continued expert local support in 3 areas: Silicon Valley, China and Germany.

- “ Art of modelling” : Predictive modelling of Battery performance inside the vehicle – **to address the outcome (safety, weight etc..)**

- “ Art of decision making”: Collaborative, intelligent decision making with **simple visual solutions** for communication with the OEM

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Any Questions?

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