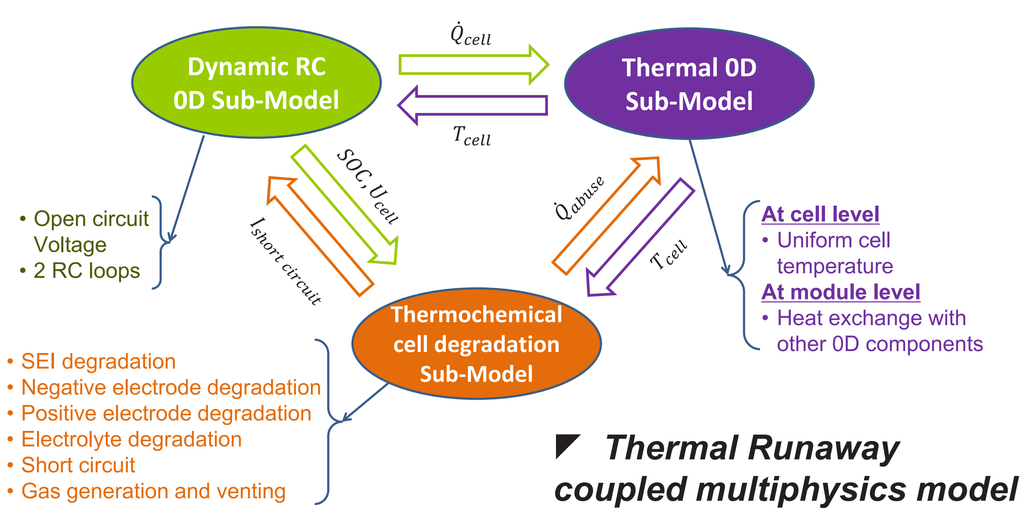
Sustainable mobility | New energies | Responsible oil and gas

Numerical simulation for seamless integration of a safe battery pack in light electric vehicle as a contribution to the DEMOBASE project

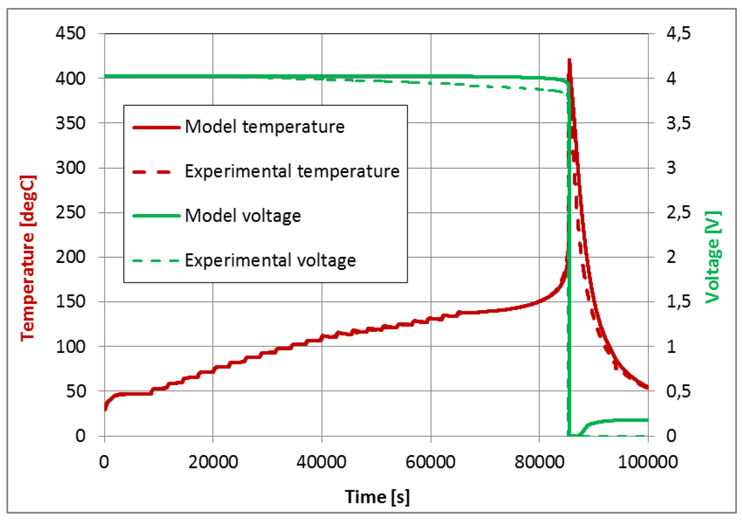
Julien BERNARD[1], Martin PETIT[1], Sara ABADA[1], Jean-Charles DABADIE[1], Rémy MINGANT[1], Joseph MARTIN[1], Philippe DESPREZ[2], Dinh An N'GUYEN[2], Sylvie Herreyre[2], Pietro PERLO[3], Marco BIASIOTTO[3], Riccardo INTROZZI[3], Amandine LECOCQ[4], Guy MARLAIR[4], Benjamin TRUCHOT[4]

[1]IFP Energies nouvelles, Rond-point de l'échangeur de Solaize, BP 3, 69360 Solaize, France; [2]SAFT, 111/113 Boulevard Alfred Daney, 33074 Bordeaux (France); [3]I-FEVS, Carignano, 50/1, 10040 La Loggia Torino (Italia); [4]INERIS, Parc Technologique Alata, 60550 Verneuil en Halatte (France).

The success of electrification will rely on the development of new electric vehicles able to tackle main challenges being high cost, autonomy and also safety. As a consequence, critical choices need to be made as soon as the development and prototyping phase. Modelling can then play a crucial role in order to anticipate and validate the choices made. This is the guideline of the DEMOBASE project [1] in order to develop an innovating EV concept meeting new market demand. In this poster we will focus on the 0D modelling of the battery thermal behaviour in nominal and abuse conditions [2]. **Can 0D approaches give a help for the pack design in the first steps of conception?**



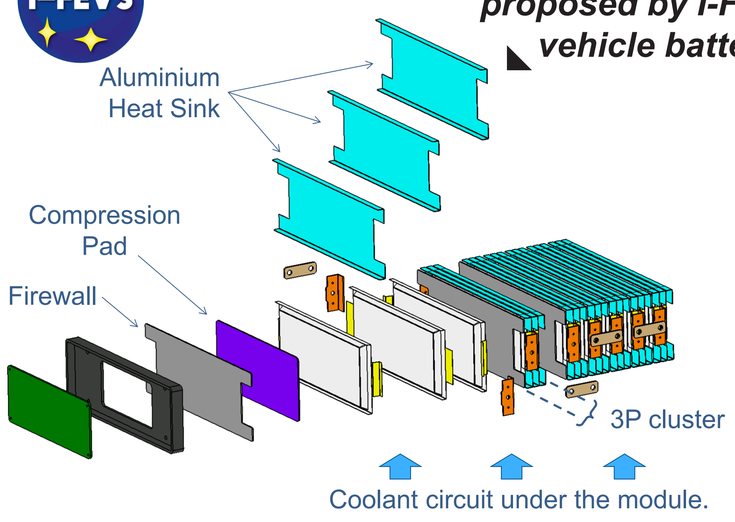
◤ ***Thermal Runaway coupled multiphysics model***



◀ ***Thermal Runaway model calibration:***

- SAFT pouch Cell Gen3 17Ah
- INERIS Heat Wait & Search abuse test
- IFPEN model [3] & simulation developed on Simcenter Amesim™ software

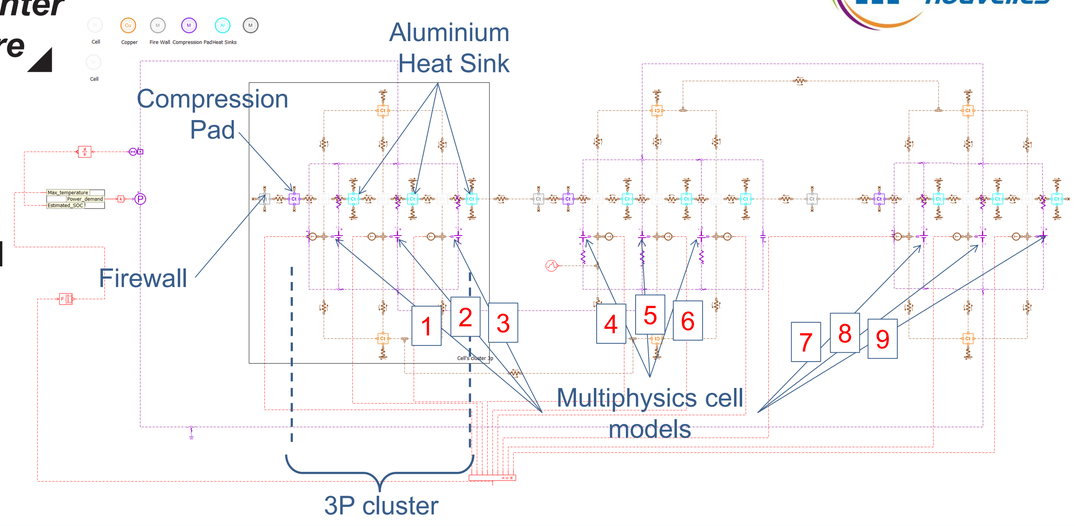
3P7S module structure proposed by I-FEVS for the vehicle battery pack ◣



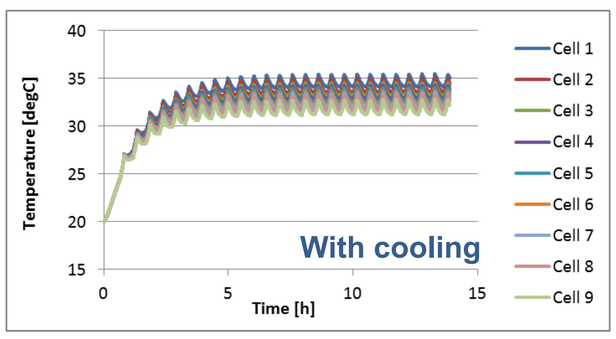
IFPEN module simulator developed on Simcenter Amesim™ software ◢

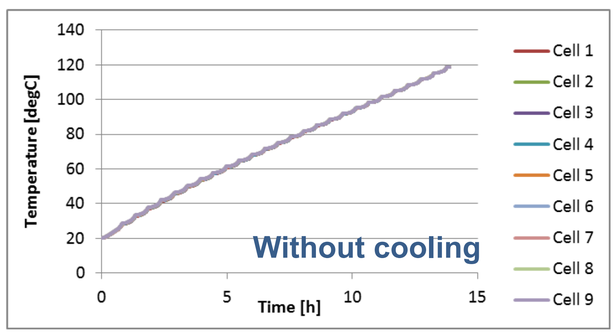
- Bloc of 9 cells (3P x 3S) modelled
- Electrical behaviour
- Thermal behaviour in nominal and abuse conditions

➡ **Very fast setup and simulations allow to explore many solutions in a pre-design step**



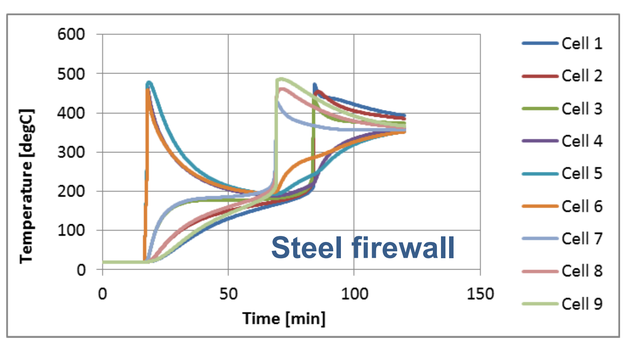
Nominal case : Sequences of 40 kW discharge 8 min / 15 kW charge

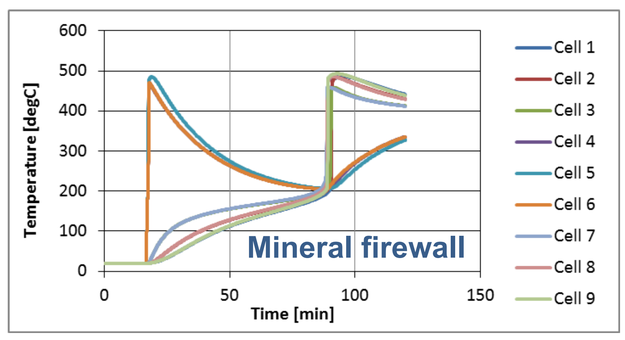




➡ No thermal runaway after 15h of cycling in both cases
➡ Cooling allow to stabilize the temperature below 35 °C

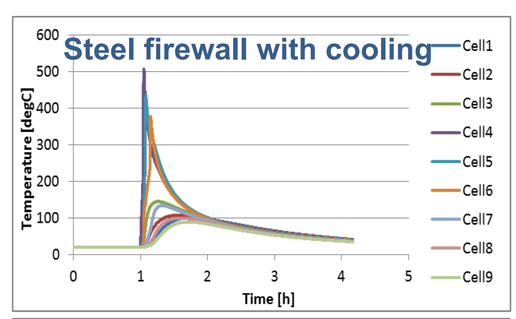
Short circuit in cluster 2 (cells 4-5-6) at t=1000s, Cooling HS, SoC 100 %

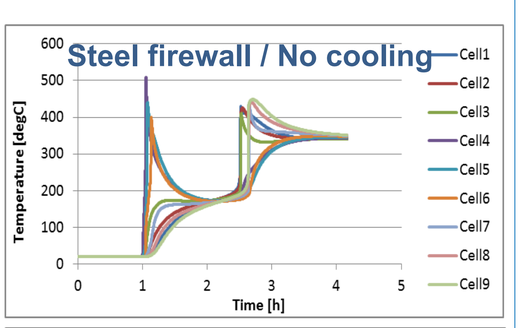


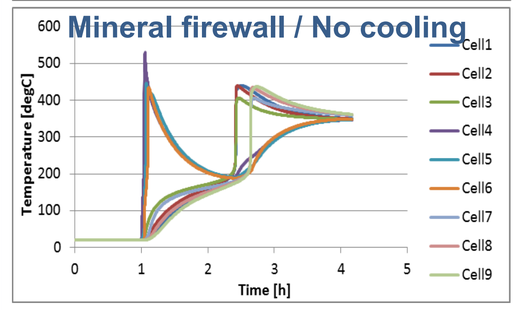


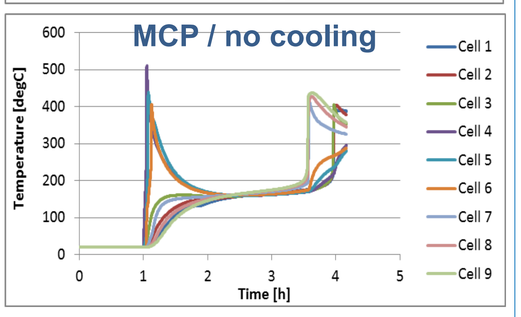
➡ Propagation of thermal runaway to the neighbouring clusters
➡ 20 min delay in propagation to next clusters by changing the firewall material

Sudden rise in Cell 4 temperature, SoC 50 %









➡ Many solutions or combined solutions could permit to delay or avoid thermal runaway propagation in the battery pack between clusters

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[1] DEsign and MOdelling for improved BAttery Safety and Efficiency. Online : https://www.demobase-project.eu/.
[2] S. Abada et al., "Safety focused modeling of lithium-ion batteries: A review," J.Power Sources, vol. 306, pp. 178–192, 2016.
[3] S. Abada et al., "Combined experimental and modeling approaches of the thermal runaway of fresh and aged lithium-ion batteries," Journal of Power Sources, vol. 399, pp. 264–273, 2018.