



# Thermal management of Electronic power steering Powerpack



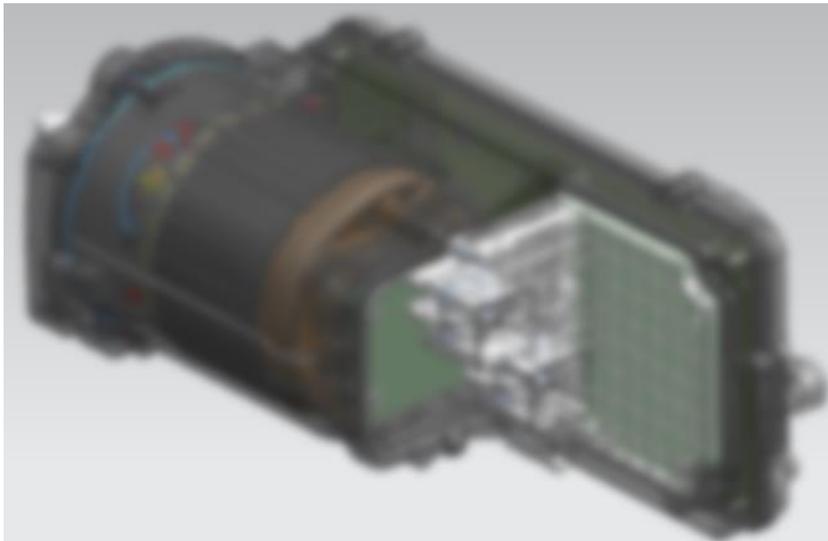
# EPS POWERPACK THERMAL-CFD SIMULATION

## Introduction:

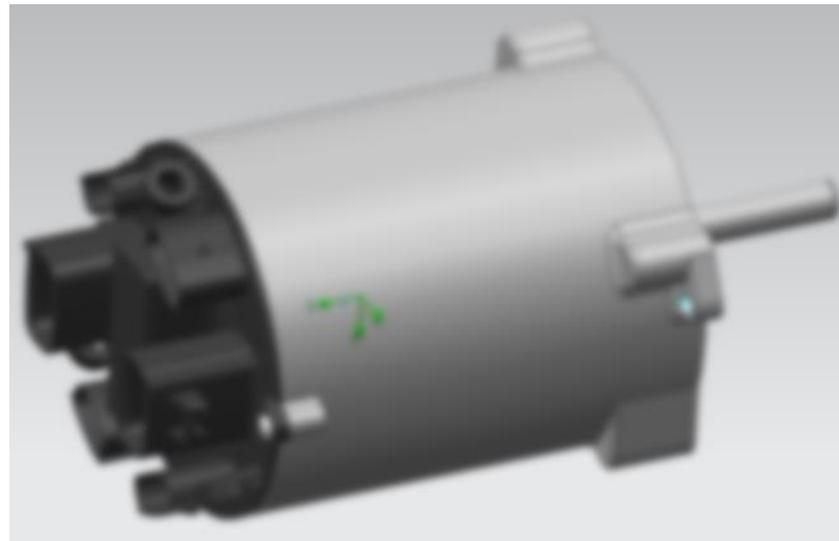
Over the past few years, AES has provided Design and optimization solutions for various Electronic Power Steering power packs with its strong Thermal and structural simulation techniques. Packaging and thermal management in these power packs are a very important part of the design to ensure their reliability in all harsh environments and extreme duty cycles.

Below are a few ranges of Power packs for which AES provided Design and CAE solutions.

## Different Powerpack assemblies



Powerpack for LCV (Side mount)



Powerpack for HCV & LCV (Cylindrical type)

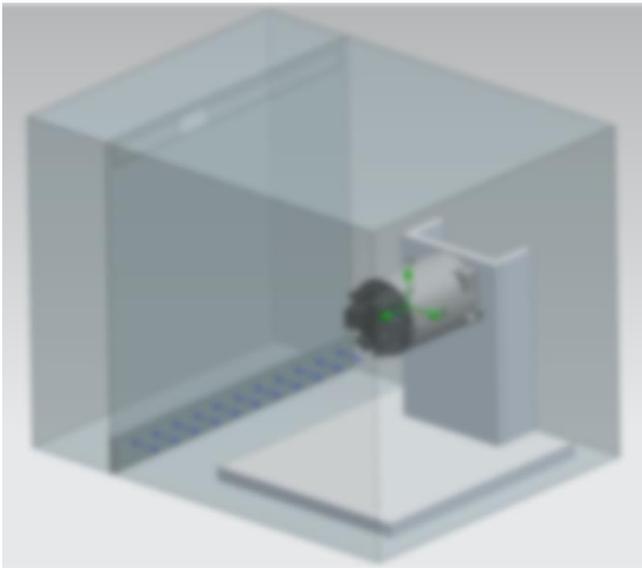


Powerpack for LCV

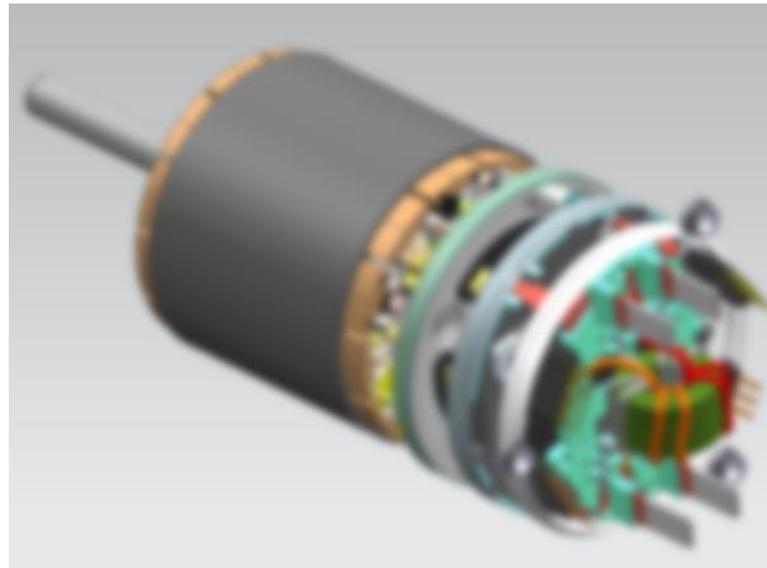
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## Objective:

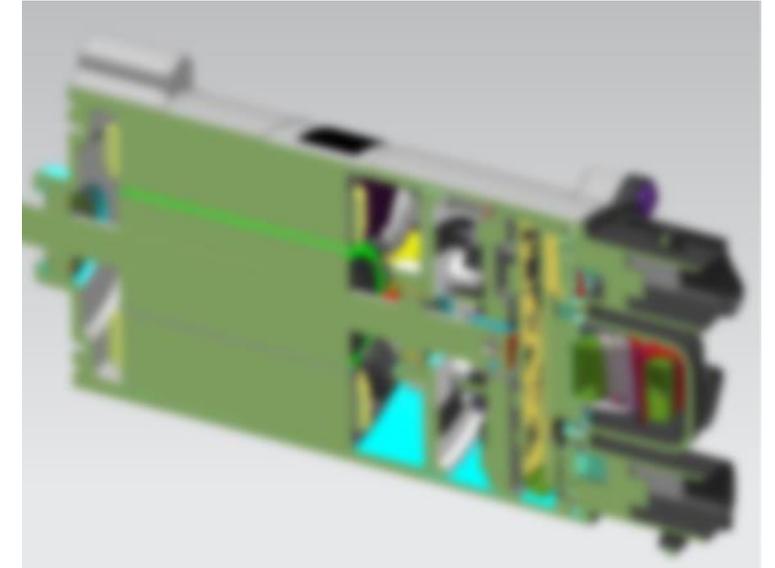
- Perform CFD thermal analysis of **Electronic Power Steering(EPS)** powerpack to analyze heat transfer, estimate maximum temperature on the components and optimize the design to keep the temperatures within allowable limits.
- Simulations are performed for **Steady State and different Transient duty cycles** to ensure operational limits of the power pack.



Typical Powerpack and enclosure assembly



Motor Assembly

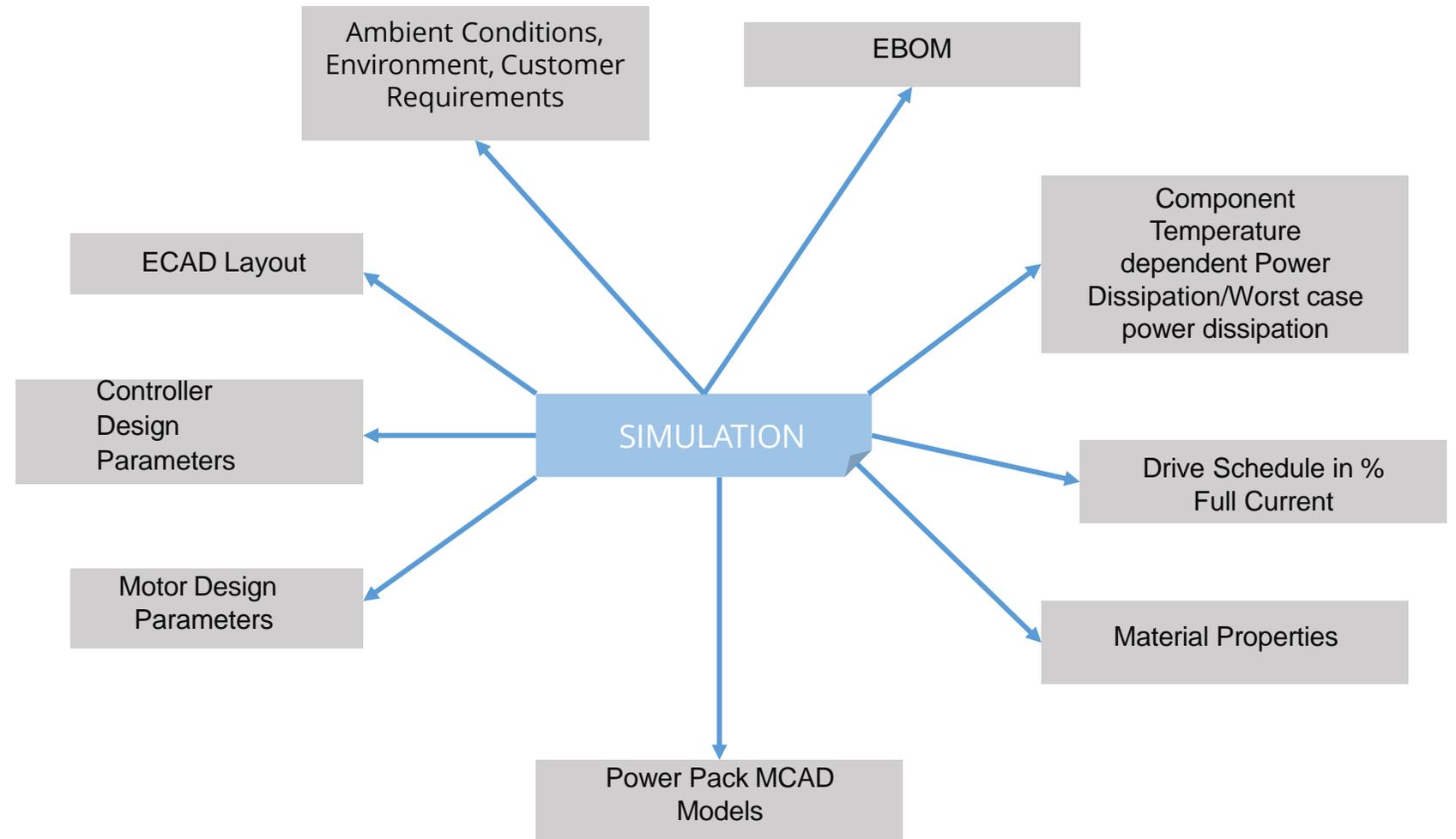


Motor Section

# EPS THERMAL DESIGN OVERVIEW

Some of the factors influencing the thermal design of the Power pack

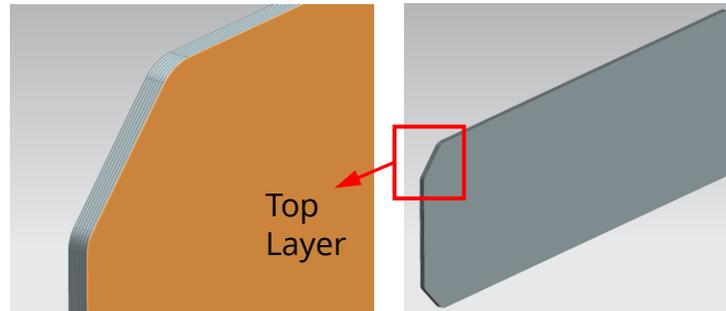
- PCB (size, height, type of conductor, laminate, Glass transition temperature, No. of layers)
- Trace Resistance, Ctrl Input voltage, PWM Frequency, Choke resistance, Joule Heating, etc.
- Motor parameters (motor speed, motor constant, line inductance, line resistance, max. motor current, copper windings, etc.)
- MOSFET, ICs (types, temperature-dependent power dissipation, thermal resistance, R On-Off Delay)
- Vias (type, number)
- Packaging (heat sinking)
- Thermal Interface Materials
- Environment (Ambient conditions)



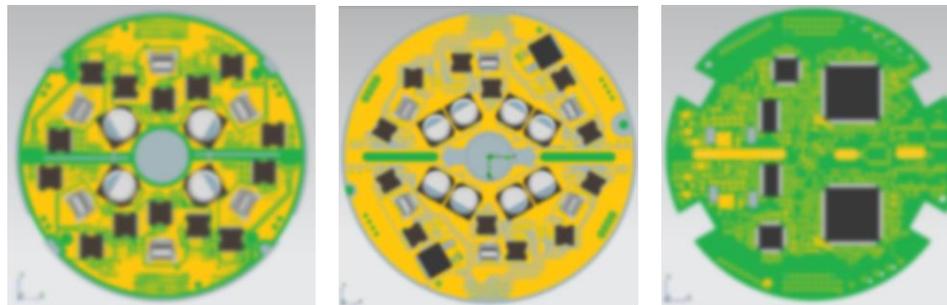
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## Challenges:

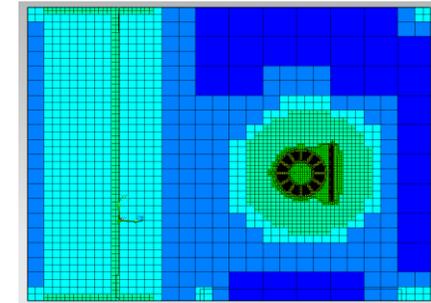
- Modelling of PCBs using EDA import with different levels of construction like **Detailed** and **Material Mapped(Smart PCB)**.
- Perform simulation for powerpack with multiple PCBs which are modelled as Material Mapped to estimate more accurate results.
- Deliver quality work and conform to the customer's standards and project schedules.



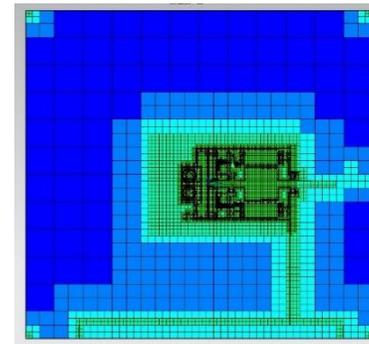
Typical Detailed PCB construction



Typical Smart PCB construction and its components



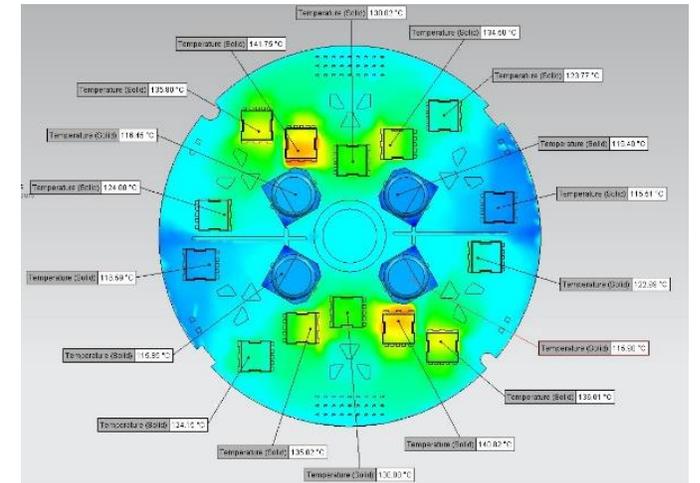
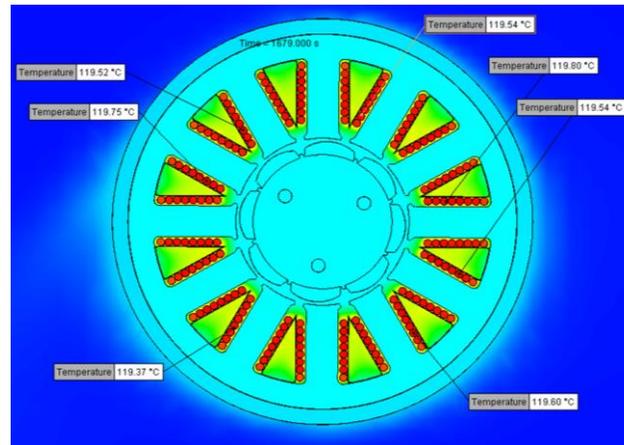
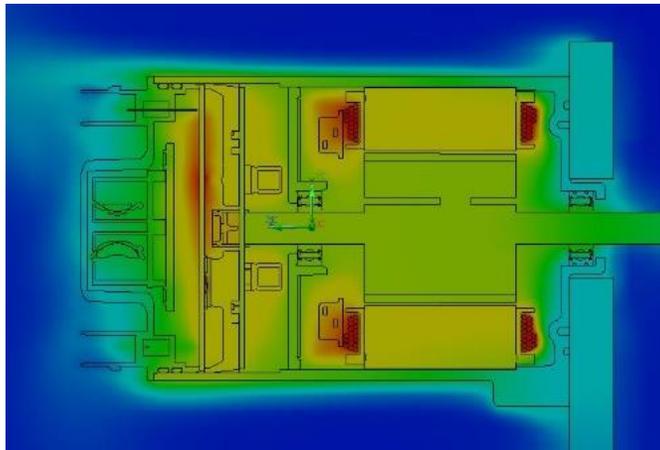
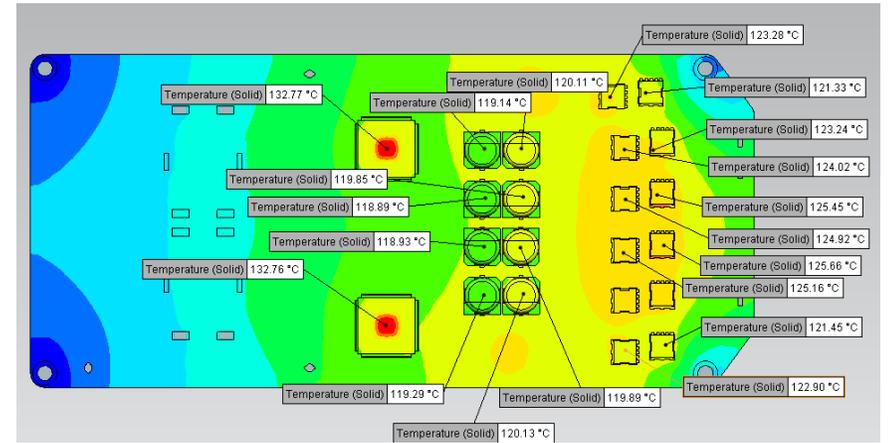
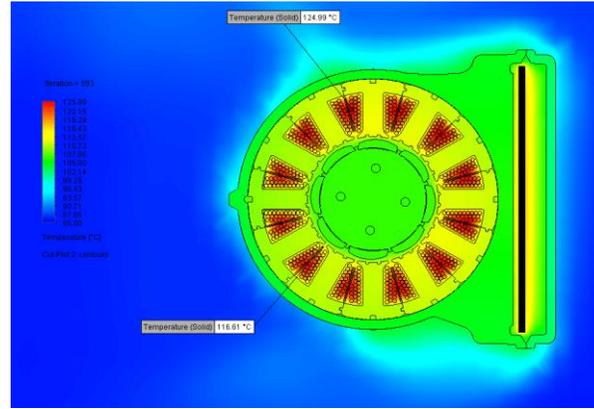
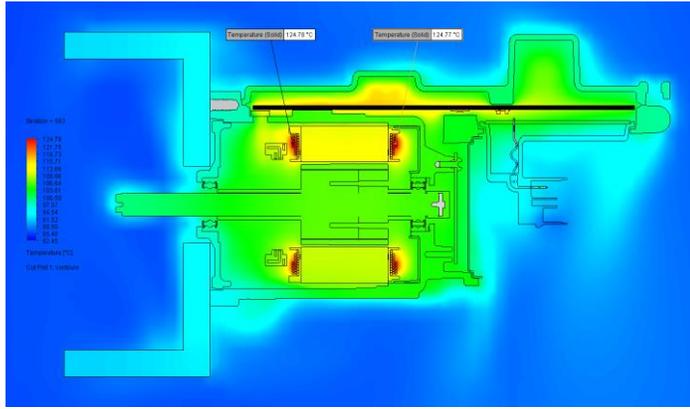
Mesh plot on plane across motor axis



Mesh plot on plane along motor axis

# EPS POWERPACK THERMAL-CFD SIMULATION

## Results:



Contour plots of Temperature along motor axis for typical powerpack

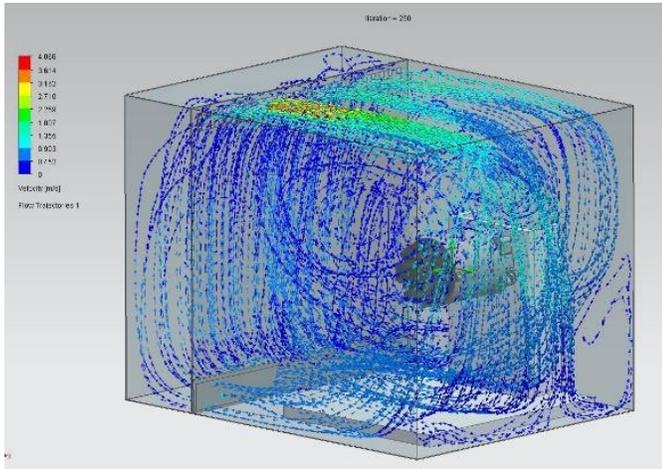
Contour plots of Temperature across motor axis for typical powerpack

Contour plots of Temperature on the surface of a typical PCB and its components

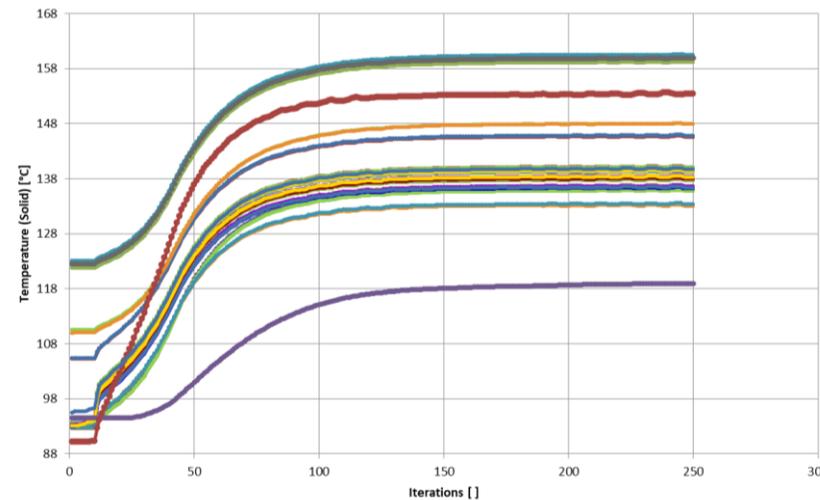
# EPS POWERPACK THERMAL-CFD SIMULATION

## Results & Benefits:

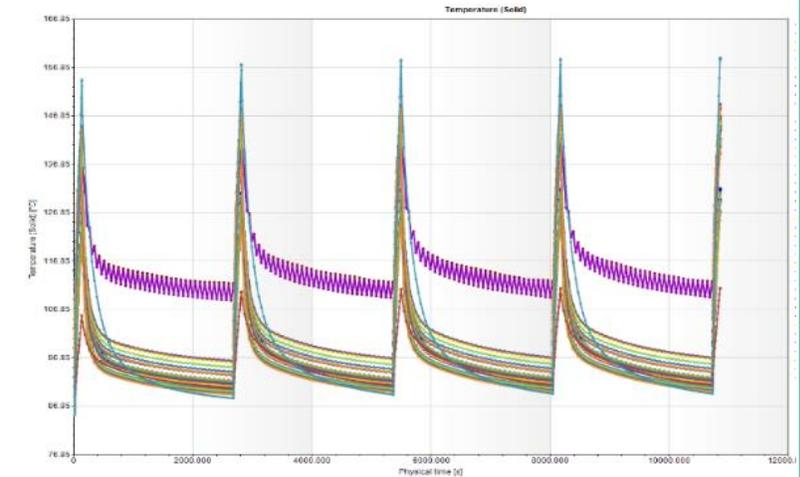
- AES ensures all inputs are received and get the queries clarified from customer through constant coordination for the timely completion of the project.
- **Automation of tasks** wherever possible to minimize the overall project execution time.
- Saved both in prototyping and development costs for customers.



Velocity vectors



Temperature plot (Goals plot) for Typical Steady State case



Temperature plot (Goals plot) for Typical Transient case

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THANK YOU