Ceres Power

Improving energy supply
efficiency with DS PLM

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> a virtual environment helping us to make better-informed decisions about how
> to optimize products.

Mark Selby
*Senior Principal
Engineer
Ceres Power*

Challenge
To develop a highly efficient,
cost-effective domestic combined
heat and power (CHP) unit that
offers a compelling alternative to
centralized power generation.

Solution
Ceres Power uses Dassault
Systèmes' Dymola from CATIA
and Abaqus FEA from SIMULIA
to simulate and evaluate the
system's performance and
cost benefits of design options
without having to build physical
prototypes.

Benefits
DS PLM solutions help Ceres
Power reduce risk and accelerate
innovation by providing
technical and commercial
insights into the implications
and effects of changing design
parameters to meet performance
specifications.

DS DASSAULT SYSTEMES

Reduced energy costs through efficient operation

Modern domestic boilers are highly efficient and generate heat at greater than 90% efficiency. However, electricity supplies to domestic installations where the boilers are located lose as much as 65% of their energy through heat loss at either generation or distribution.

The adoption of Combined Heat and Power (CHP) units, which utilize the thermal energy that is normally wasted, significantly improve energy supply efficiency. According to the International Energy Agency, more efficient production and use of energy could be the single largest and most cost-effective contributor to reductions in CO2 emissions.

Ceres Power is a world leading alternative energy company based in the UK developing fuel cell technology for use in small scale CHP products for the residential sector and in energy security applications. The use of a Ceres Power fuel cell module installed in a home is a compelling alternative to centralized generation with its associated transmission and heat losses.

Green box

Ceres Power fuel cells convert fuel and air directly into power and heat through a quiet, efficient, solid-state electro-chemical reaction. Fuel cells generate power significantly more efficiently than internal combustion engines because they convert chemical energy directly to electrical current eliminating the need for a mechanical intermediate phase. Heat is also liberated by fuel/air reaction and can be captured and coupled into a heat exchanger to meet local heating requirements.

Ceres Power uses Dassault Systèmes Dymola, part of the CATIA portfolio, and Abaqus FEA from SIMULIA, to simulate and evaluate the system's performance and cost benefits of design options without having to build physical prototypes.

"We evaluate alternative designs with Dymola because it allows us to simulate system performance and cost benefit analysis in a virtual environment," said Mark Selby, Senior Principal Engineer, Ceres Power. "This helps us to make better-informed decisions about how to optimize products. This not only reduces the need to make physical prototypes, but it also lets us measure the implication of decisions at various production levels. This is because alternative technologies become available at different production volumes. Dymola provides insight into the effects of changing a component specification or arrangement in this context.

> Abaqus FEA allows structural and thermal simulation, in realistic detail, which enables our team improve our understanding and the functional performance of our Fuel Cell Stack.

Matt Harrington
Principal Engineer
Ceres Power

The software also reveals its usefulness for the control system which is developed against the same models using co-simulation technology. This reuse of effort is vital to being a competitive company.

Power Lines

"Dymola takes out guess work so that physical prototypes have predictable performance. This means that we build far fewer prototypes than would otherwise be required, saving thousands of hours in the development cycle," said Selby. "Risk is reduced with this methodology and high-level decision support is introduced because Dymola is able to simulate in real-time the precise operational characteristics of design options. It also allows us to introduce 'faults' to check system response and take appropriate design or control programming decisions. Dymola demonstrates great benefits to Ceres Power's communication with its supply chain by allowing very accurate target specifications to be issued and balances to be introduced on target cost/performance criteria. "There is always a trade off between price and performance in the supply chain. Dymola helps us to get maximum value at the best possible price while fully understanding both commercial and technical cost benefit choices, and their implications."

The power of three

Dymola is of benefit in three distinct areas at Ceres Power. In the Advanced Engineering environment, it helps develop and support component design through the simulated application of physics. In relation to Control Systems development, it allows functions to be observed and programmed and their effects monitored and developed. In a Systems Integration role, Dymola reveals inter-relationships and ensures that electric and mechanical systems and the software that links them all work in harmony.

Another aspect of development at Ceres Power was explained by Matt Harrington, Ceres Power Principal Engineer. "Abaqus FEA analysis software is used alongside Dymola to simulate mechanical forces and resultant stresses arising through manufacturing and assembly. Furthermore, by integration with third- party computational fluid dynamics (CFD) software, component and assembly responses to thermal and pressure differentials can clearly be visualised and functional designs enhanced. A common use is assembly simulation of gasket sealing stresses integrated with endplate designs. A new application is current field visualization around electrical contacts within the fuel cell, further illustrating the range and versatility of the Abaqus FEA tool."

Harrington concluded: "Abaqus FEA allows structural and thermal simulation, in great detail, which enables our team to improve understanding and functional performance of our fuel cell stack. This is at a supporting sub-level to Dymola which provides overall system operability simulations."

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ðS SIMULIA

ðS DASSAULT SYSTEMES