

INDUSTRIAL MACHINERY

Cummins

Using simulation-based product development to predict and optimize electrolyzer noise

Product

Simcenter

Business challenges

Quietly produce hydrogen at night to mitigate the cost of electricity and comply with local regulations

Reduce time and cost of building prototypes of very large machines to ensure acoustic compliance

Find a new method to simulate acoustic performance of large machines with multiple broadband noise sources

Keys to success

Model and simulate acoustic performance of large machines with Simcenter 3D Ray Acoustics

Leverage smooth learning and adopt simulation software with Siemens support and training services

Results

Used simulation to accurately predict noise prior to manufacturing to promote sustainability

Leveraged Simcenter 3D to simplify model creation and reduce model preparation time from hours to minutes

Predicted system behavior and enhanced HyLYZER acoustic performance

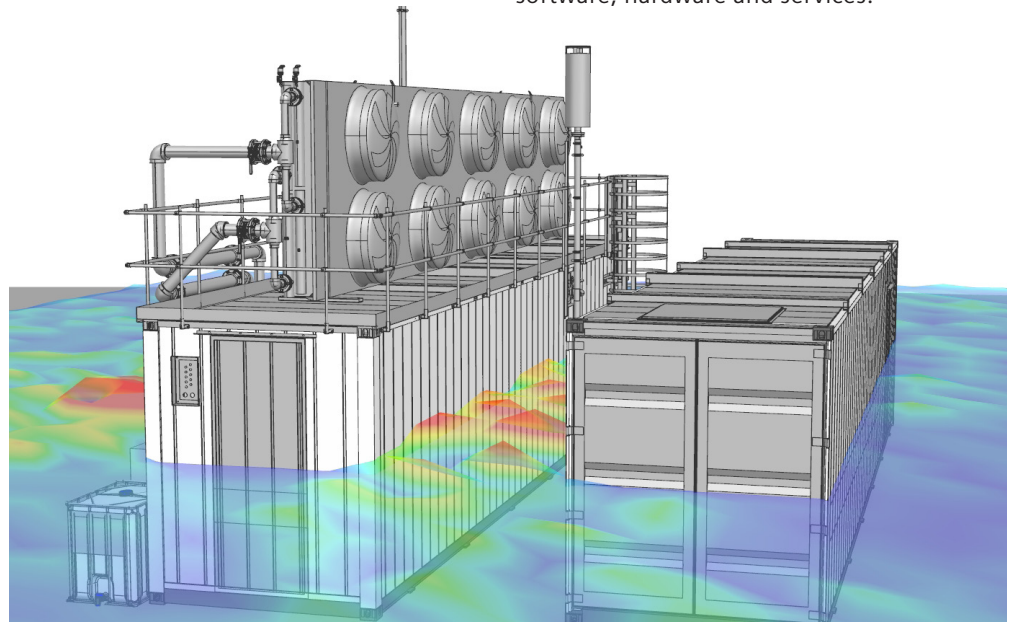
Leveraging Simcenter to simplify model creation and reduce model preparation time from hours to minutes

From fossil fuels to new power

Cummins, headquartered in Columbus, Indiana, is a global power technology leader most known for its diesel engines and generators. Comprised of 60,000 team members worldwide and dispersed throughout complementary business units, they design, engineer and manufacture power solutions for the last 100 years. As Heraclitus said, "Nothing is permanent except change."

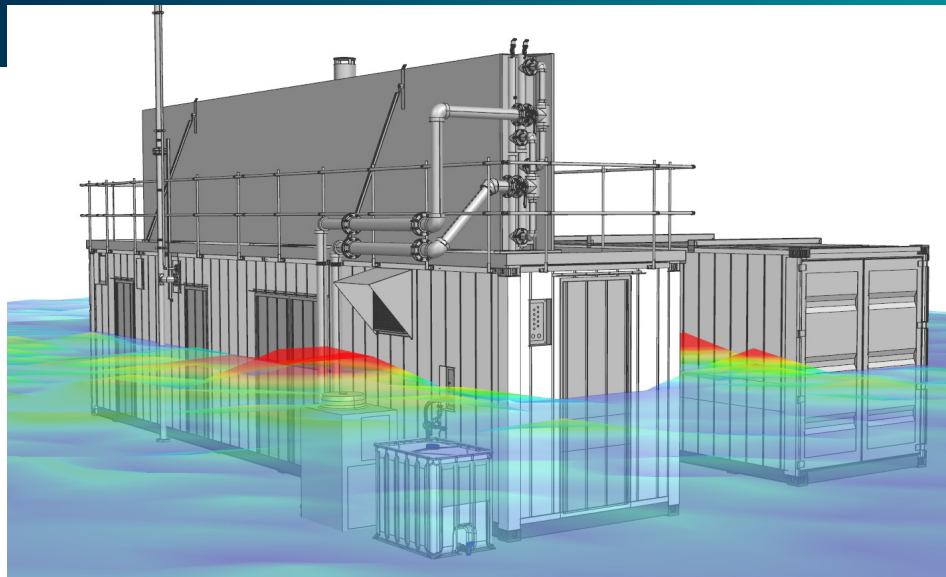
In this shifting world where decarbonization is the business driver for many corporations, new technologies and product strategies are imperative for Cummins to power a more sustainable future.

Pivoting away from traditional fossil fuel burning systems and adopting cleaner technologies, Cummins is leveraging its many decades of research and innovation to develop new power solutions that use natural resources more sustainably. Battery systems, fuel cells and hydrogen production are all included in this new power portfolio. Cummins partnered with Siemens Digital Industries software to use Simcenter 3D™ software to simulate acoustic behavior of electrolyzer. Simcenter 3D is part of the Siemens Xcelerator business platform of software, hardware and services.



“At the end of the day, using Simcenter helped us achieve a higher confidence level in the products acoustic performance before the manufacturing phase.”

Rohit Saha
Simulation-based Customer
Integration Manager
Cummins



The next generation of green hydrogen

Hydrogen plays a major role in clean power and as society embarks on the journey toward decarbonization, the role of clean hydrogen is critical. Think back to your first chemistry course – you learned about the periodic table of elements and the simplest element on earth is hydrogen.

It doesn't typically exist by itself in nature and must be produced from compounds that contain it, like water (H_2O). As of now, approximately 95 percent of the world's hydrogen is still produced from fossil fuels. Cummins is one of the few companies with expertise in clean zero-carbon hydrogen generation using electrolysis – the splitting of water molecules into hydrogen and oxygen. HyLYZER

polymer electrolyte membrane (PEM)

Electrolyzers, which are on-site hydrogen generators, are a result of Cummins' years of continuous improvement and innovation. The system is designed for easy on-site installation. Electrically powered and modular units yield a scalable hydrogen generation system.

Dealing with tradeoffs

Tradeoffs are important in engineering. When critical decisions are made early in the design phase; how do we ensure it is the best choice?

Take the HyLYZER product, for example, electricity is usually cheaper at night, so it makes business sense to produce the hydrogen at night. However, the nighttime noise levels must meet stringent local sound regulations.

// Using Simcenter Ray Acoustics has reduced our modeling and solve times from weeks to hours, leaving more time for what-if studies on each HyLYZER configuration.”

Sanjay Kabra
Technical Advisor (NVH) VIC Customer Engineering
Cummins

One might say, "let's just build a prototype and measure the actual sound levels," which is an acceptable response if each system was the same, but these machines are extremely large, expensive to prototype and scalable/modular. Additionally, each modular configuration can produce different sound levels, which would vary from initial physical testing results and not to mention each installation site may have unique local sound regulations.

As a result, the timing and cost constraints for physical prototype testing were too high-risk for Cummins, so it was decided to leverage its extensive simulation experience and evaluate potential software solutions to ensure acoustic compliance in the initial product development stage.

Predicting sound levels in a short time

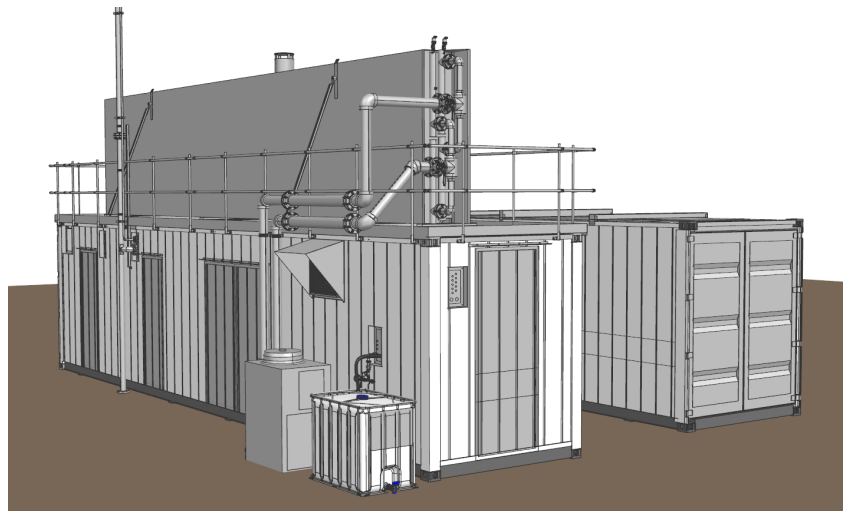
Cummins has been at the forefront of using simulation technologies in its design for noise vibration and harshness (NVH) excellence. Cummins teams led by Rohit Saha, simulation-based customer integration manager, and Sanjay Kabra, technical advisor (NVH) VIC customer engineering, are already exploiting the traditional finite element method (FEM) and boundary element method (BEM) to address component and subsystem level performance.

At the HyLYZER system level, the problem size runs into tens of millions of degrees-of-freedom (DOF), making it computationally challenging despite advances in high-performance computing hardware. Traditional acoustic simulation methods using FEM and BEM are impractical to use on these large models with multiple broadband noise sources.

Cummins already had a close partnership with Siemens and they introduced Simcenter Ray Acoustics as a solution.

Unlike FEM or BEM acoustic solvers, ray acoustics solutions are not based on a fine discretization of the domain and thus, a coarse mesh can be used. Using Simcenter Ray-Acoustics can help you simplify model creation and use tessellated meshes to reduce the model preparation time to a few minutes. This, along with the inherent fast solver times, enabled Cummins to predict the system behavior for the full frequency range in a few minutes. With these enhanced predictive capabilities, Cummins delivered on the HyLYZER performance to his end customer.

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Solutions/Services

Simcenter 3D Ray Acoustics
[siemens.com/simcenter-3d](https://www.siemens.com/simcenter-3d)

Customer's primary business

Cummins compact and modular electrolyzers are powering cleaner vehicles at hydrogen fueling stations worldwide. The company offers solutions everywhere from Los Angeles to Brussels and beyond. On-site, on-demand and with the power to decarbonize, Cummins technology is helping to drive the transition away from carbon fuels.

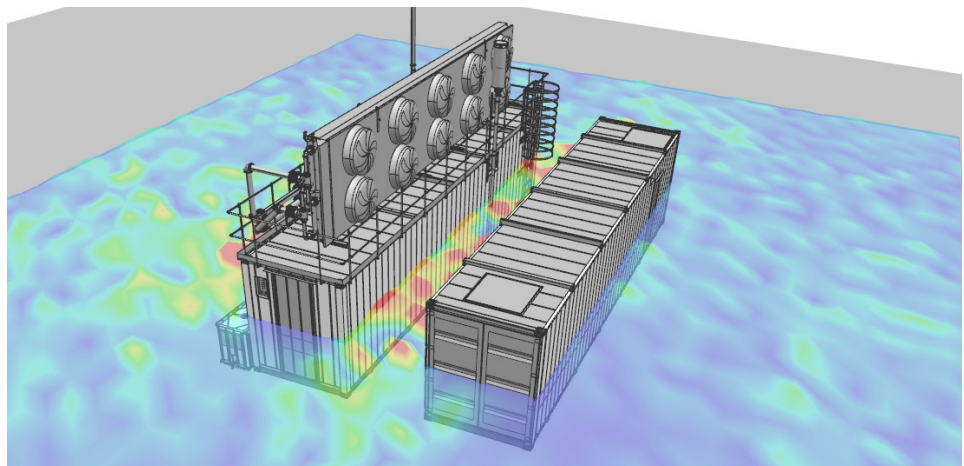
Customer location

Columbus
Indiana

Easy adoption of the software

Learning about a new tool and technology is always a challenge for any engineer. Siemens support and training services provided a fast path for Cummins engineers to realize the value of their investment, enabling a smooth adoption and short learning curve. "My background is structural FEA, so ray acoustics was new to me," says Kabra. "With some guidance from Siemens, I was able to get up to speed quickly, build a model and have results ready."

"Using Simcenter Ray Acoustics has reduced our modeling and solve times from weeks to hours, leaving more time for what-if studies on each HyLYZER configuration," says Kabra. "We can't afford to identify performance issues after the product has been manufactured and assembled, so being able to prove our design using simulation in a short amount of time helps us meet project deadlines and keep our customers happy. At the end of the day, using Simcenter helped us achieve a higher confidence level in the products acoustics performance before the manufacturing phase."



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Sanjay Kabra
Technical Advisor (NVH) VIC Customer Engineering
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