# Are 3D Computational Models Good Enough for Gas-Fired Emissions Control Systems?

*Why physical models may be the key to assuring performance*

HOLDEN, MA, USA, December 15, 2016 /EINPresswire.com/ -- Using three-dimensional computational fluid dynamics (CFD) tools have become common practice for evaluating and testing emissions control systems of modern gas-fired power plants. CFD can be ideal for simulating thermal variations or chemistry, and can potentially be completed at low cost. But physical models still have their place. In fact, many designers continue to rely on physical scaled flow models to assure that their systems will perform as designed.

Why can't original equipment manufacturers (OEMs) rely completely on CFD? Modern gas-fired power generation units have complex exhaust flows, expanding from a small, circular gas turbine exhaust duct into a larger rectangular duct cross-section that includes the heat recovery steam generator (HRSG) and emission control systems. Physical models, typically fabricated using acrylic, wood, aluminum, and/or steel at around one-tenth the size of the actual equipment, can better simulate the intricate flow patterns caused by the complex geometry.

How should a vendor determine when to use a physical model, rely on CFD tools—or do both? To decide which approach is appropriate, experts at Alden offer four important considerations:

1. Are the CFD users experienced with power plants?
Some OEMs rely on in-house CFD users or consultants with power plant experience who understand the intricacies of turbine discharge, ammonia injection systems, catalysts and other specialized considerations. However, procurement and low-bid scenarios can mean working with CFD engineers who have more experience with race cars or airplane wings than a HRSG. Even worse, they may end up with engineers straight out of college who understand numerical theory, but have no industrial experience. Having the right industrial experience is key to obtaining accurate results. Without it, a physical model should be considered. In cases where an existing CFD model was originally performed by inexperienced staff, incorporating a physical model into any potential modifications is strongly recommended.

2. Is there potential for "gas flow sneakage?"
Small regions in which exhaust flow can choose the path of least resistance, essentially "sneaking" around catalyst or flow distribution devices, can cause big problems as air goes untreated. If these regions cannot be properly resolved in a CFD model without creating an impractically large computational mesh, then a physical model may be the most practical approach.

3. Can important details of the flow path be modeled with CFD? HRSG units contain fine geometry that is not always practical to model explicitly with CFD. For example, where perforated plates are used to induce pressure drop and uniform flow distribution, a CFD model would typically parameterize the geometry as an infinitesimally thin porous jump, in which the pressure drop is a function of the local velocity. When the flow is highly three-dimensional, that approach may not be valid, and a physical flow model that uses actual perforated plates can add a high level of confidence to the design process for minimal investment. If the two models don't agree, an analysis can reveal where there

may be uncertainties in the design, allowing for the appropriate planning and risk management.

4. How different is this design from a proven plant now operating in the field?
In spite of the number of HRSGs built in a year, designs are not often uniform. Each plant is bid separately, and builders may use different OEMs for each component to accelerate the schedule and/or take advantage of the best pricing and equipment available for each site. However, if an HRSG design is very similar to an existing unit in the field that is performing well, then a CFD analysis that shows how the new unit would perform similarly may be all that is needed.

When time and budget allow, using both tools together is often the best course of action, particularly in challenging conditions such as ammonia injection for selective catalytic reduction of nitric oxide. However, asking these few key questions upfront can help HRSG designers make confident decisions about which approach— CFD tools, physical models, or both— is appropriate for their situation.

About Alden

Alden is an internationally acclaimed leader in solving flow-related engineering and environmental problems. Founded in 1894, Alden provides compliance, environmental services, physical and computational flow modeling, flow meter calibration, and field services.

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