

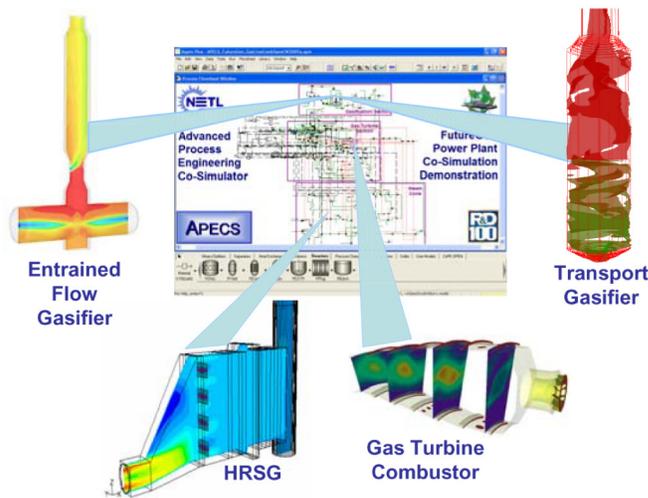


Advanced Process Engineering Co-Simulation for Energy and Environment R&D

Introduction

Developed in collaboration with partners in industry, academia, and government, the award-winning† Advanced Process Engineering Co-Simulator (APECS v2.0) is a powerful enabling software solution that combines process simulation with equipment-level simulations having varying degrees of fidelity and computational speed. Using APECS, plant design engineers can effectively integrate and efficiently solve and analyze co-simulations combining commercial steady-state process simulators such as Aspen Plus® with equipment models - this includes high-fidelity computational fluid dynamics (CFD) models based on ANSYS FLUENT®, one of the world's leading commercial software packages for detailed flow analysis of process equipment.

APECS v2.0 is built on the process industry CAPE-OPEN software standard and the integrated access, workflow, and data services of the ANSYS® Engineering Knowledge Manager™ (EKM™). Version 2 also provides an innovative off-line capability for systematic generation and analysis of reduced order models (ROMs) based on 2D and 3D CFD models. The APECS ROM Builder is integrated seamlessly with ANSYS® DesignXplorer™ (DX) for improved process/equipment design optimization.



APECS v2.0 Co-Simulation of an Advanced Gasification-based Power Plant with Carbon Capture

† 2004 R&D 100 Award (APECS), 2006 and 2007 Federal Laboratory Consortium (FLC) Excellence in Technology Transfer Awards (APECS), 2008 R&D 100 Award (APECS with EKM), 2011 R&D 100 Award and 2011 FLC Mid-Atlantic Regional Technology Transfer Award (APECS v2.0 with ANSYS DX and ROM Builder)

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U.S. DEPARTMENT OF **ENERGY**

The process and energy industries can deploy APECS v2.0 as a complete engineering solution for fostering rapid technology development, reducing pilot and/or demonstration-scale facility design time, and lowering the cost and technical risk in realizing high-efficiency, near-zero emission plants of the future.

Application to Power Plants with Carbon Capture

At NETL, system analysts are evaluating and optimizing potential power plant configurations using APECS v2.0 co-simulations with detailed CFD models of key equipment items (e.g., combustors, gasifiers, synthesis gas coolers, gas turbines, heat recovery steam generators, and fuel cells). For example, integrated gasification combined cycle (IGCC) plant configurations are optimized with respect to gasifier performance where fluid dynamics strongly affect synthesis gas quality and carbon conversion. CFD models are also used to analyze gas turbine performance where the blending of air and fuel is at the heart of power generation, efficiency, and environmental compliance. APECS v2.0 enables NETL engineers to better understand and optimize the coupled fluid flow, heat and mass transfer, and chemical reactions that impact overall power plant performance.

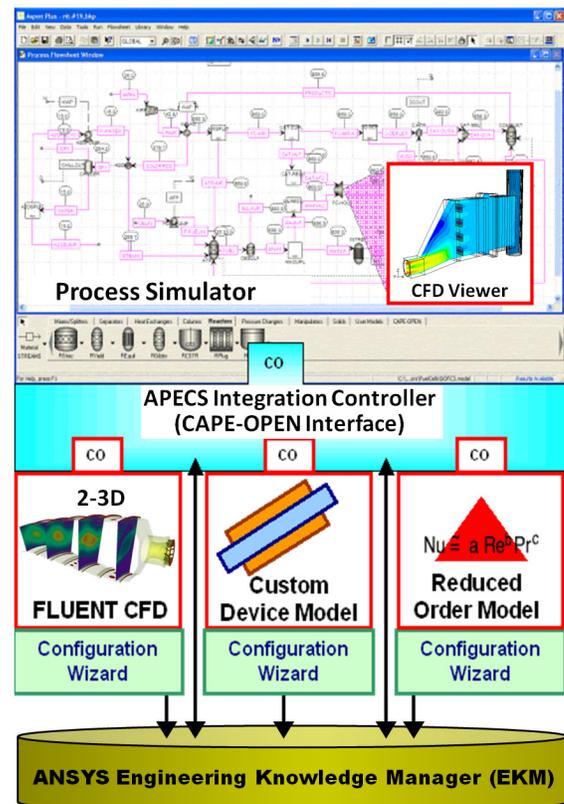
Benefits for Plant-Level R&D

- Helps engineers to better *understand and visualize* the fluid flow behavior that impacts process design and operation
- Considers *detailed equipment models* in the context of *plant-wide simulations* with recycle loops, heat integration, and water management
- Enables rigorous *process trade-off studies* with respect to CFD-related model parameters, including interactions among connected equipment items
- *Reduces potential for suboptimal designs* by using the same physical properties and reaction kinetics in the CFD equipment and process stimulation models
- *Speeds technology development* by reducing pilot and/or demo-scale facility design time

APECS v2.0 Features

- Compatible with widely unitalicize CAPE-OPEN compliant process simulators such as Aspen Plus®, ChemCad, COFE, Aspen HYSYS®, PRO/II®, and UniSim® Design
- Configuration Wizards to prepare equipment models as CAPE-OPEN compliant models for use in process simulation
- Design productivity and workflow improvements across the enterprise with enhanced leverage of the model/data management capabilities of the latest release of ANSYS® EKM™

- Enhanced support for advanced combustion and dense multiphase-flow gasification in ANSYS® FLUENT®, fostering greater innovation in rigorous process and energy plant design
- Access to ANSYS® DX's wide variety of efficient ROM and state-of-the-art design of experiment options for enhancing the accuracy, flexibility, and performance of APECS co-simulation driven process/equipment development
- Novel and efficient tools for generating time-averaged equipment ROMs based on transient Eulerian-Eulerian CFD simulations for use in plant-wide, steady-state co-simulations
- Tailored and powerful solution strategies based on a hierarchy of equipment models with varying levels of fidelity and computational speed
- First-of-a-kind capability to optimize equipment design via geometry re-meshing and parameterization in the context of an overall process
- Serial or parallel execution of CFD models on distributed Windows or Linux computers
- Easy visualization of 2D-3D CFD results



Software Architecture for APECS v2.0 with ANSYS® EKM™