

VE-PSI: Virtual Engineering Process Simulator Interface

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7

The Department of Energy's (DOE's) National Energy Technology Laboratory (NETL) and its R&D collaboration partners, Ames National Laboratory (ANL) and Reaction Engineering International, developed the 2009 R&D100 award-winning Virtual Engineering Process Simulator Interface (VE-PSI) software to facilitate the collaborative design of next-generation energy plants within a virtual engineering environment. Meeting the increasing demand for clean and affordable energy, while addressing climate change, is arguably the most important challenge facing the world today. Using VE-PSI, energy plant design engineers can integrate, analyze, and optimize a wide variety of modeling and simulation data within an immersive, interactive, three-dimensional (3D) energy plant walk-through virtual environment. Engineering data sources include not only plant/process-level mass and energy balance models, but also equipment-level models based on computational fluid dynamics (CFD) and computer-aided design (CAD). VE-PSI enables the use of these virtual process and equipment models across the entire energy plant lifecycle from process synthesis and design to plant operations and management. Such capabilities provide engineers with the ability to create virtual prototypes of new plant designs more quickly and efficiently and at less cost than ever before, as well as improve existing designs before expending time and materials on physical prototypes. At NETL, system analysts are applying the VE-PSI technology to help develop high-efficiency, near-zero emission plants such as DOE's Future-Gen coal-fired, gasification-based plant with combined cycle electricity generation and capture and sequestration of carbon dioxide emissions.

To facilitate effective technology transfer, VE-PSI is offered as open-source software within the Virtual Engineering Suite (VE-Suite) and is available for download at <http://www.vesuite.org> under the GNU Lesser General Public License. This has allowed the flow of the technology to academia, national laboratories, and industry, as well as enabled a reverse flow of technology into VE-PSI from external researchers. At

the DOE's Idaho National Laboratory (INL), researchers are applying VE-PSI to develop integrated virtual engineering simulations for bioenergy applications. The VE-PSI technology allows INL professionals to analyze and better understand the complex relationships between biomass feedstock supply system designs and downstream biorefinery processes. Together with researchers from ANL, NETL is applying VE-PSI to couple Aspen Plus® process simulations and FLUENT® CFD equipment models with 3D plant-wide CAD models of integrated gasification combined cycle (IGCC) systems in VE-Suite software. This integration is enabled by the VE-PSI technology and represents a necessary step in the development and deployment of virtual power plant co-simulations at NETL. At ALSTOM Power, a major worldwide industrial player in equipment and services for power generation, design engineers are applying VE-PSI for a wide variety of advanced energy applications including natural gas combined cycles, coal-fired oxy-combustion power plants, and chemical looping combustion and gasification systems. VE-PSI provides opportunities for a broad audience of ALSTOM project stakeholders to collaborate within a highly integrated and comprehensive virtual process engineering environment.

The open-source distribution of the VE-PSI software technology has led to the transfer of virtual process engineering technology to academia, national laboratories, and industry. Continued research, development, deployment, and demonstration of such technology will help the process and energy industries to address the grand challenge of designing next-generation plants with higher efficiencies and improved environmental performance.

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