PA.22 Recent Advances in Power Systems Modeling

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Abstract

Two projects supported by the Department of Energy's Federal Technology Center (DOE/FETC) have led to significant improvements in the ability to model the performance and cost of conventional and advanced power systems. A hallmark of these models is the capability to explicitly incorporate the effects of uncertainty in performance and cost parameters. These capabilities address not only process simulation, but also process synthesis and optimization.

One project has focused on advanced environmental control technologies for conventional pulverized coal power plants. The results of this work are embodied in a computer model called the Integrated Environmental Control Model (IECM). Recently, a PC based version of this model has been completed. The IECM allows a user to synthesize a power plant environmental control design by choosing from a menu of components and technologies for pre-combustion, combustion and post-combustion controls. Current options include a full suite of current commercial technologies, plus several advanced systems supported by DOE. The model is operated via a user-friendly graphical interface running under Windows. Power plant performance, emissions and cost results can be displayed probabilistically or in conventional deterministic form. The IECM framework is readily capable of being expanded to include a broad variety of additional technologies consistent with DOE's Vision 21.

A second project has developed advanced computational methods for synthesizing process flowsheets and optimizing flowsheet designs under conditions of uncertainty. These powerful new capabilities have been built around the public version of the Aspen modeling system used by DOE/FETC. Applications to date have focused on case studies of environmental control options for advanced power systems using integrated gasification combined cycles (IGCC). Because of the very large number of alternative flowsheets that can potentially be synthesized by selecting different process components (e.g., different gasifiers, coals, oxidants, cleanup systems, turbines, etc.), and different process conditions (e.g., temperatures, pressures, vessel dimensions), the selection of an optimal process configuration to meet a given set of objectives is now beyond the capability of expert designers. The new computer-aided design capabilities were developed to address this problem. Case study results show the potential for significant cost savings from the judicious selection and integration of system components, together with component optimization. Objective functions for process synthesis and optimization also can be specified probabilistically to identify designs that are robust in the face of uncertainties.

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