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GASIFICATION

ENHANCED IGCC REGULATORY CONTROL AND COORDINATED PLANT-WIDE CONTROL STRATEGIES FOR IMPROVING POWER RAMP RATES

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Abstract:
As part of ongoing R&D activities at the National Energy Technology Laboratory's (NETL) Advanced Virtual Energy Simulation Training & Research (AVESTAR™) Center, this paper highlights strategies for enhancing low-level regulatory control and system-wide coordinated control strategies implemented in a high-fidelity dynamic simulator for an Integrated Gasification Combined Cycle (IGCC) power plant with carbon capture. The underlying IGCC plant dynamic model contains 20 major process areas, each of which is tightly integrated with the rest of the power plant, making individual functionally-independent processes prone to routine disturbances. Single-loop feedback control although adequate to meet the primary control objective for most processes, does not take into account in advance the effect of these disturbances, making the entire power plant undergo large offshoots and/or oscillations before feedback action has an opportunity to impact control performance. In this paper, controller enhancements ranging from retuning feedback control loops, multiplicative feed-forward control and other control techniques such as split-range control, feedback trim and dynamic compensation, applicable on various subsections of the integrated IGCC plant, are highlighted and improvements in control responses are given. Compared to using classical feedback-based control structure, the enhanced IGCC regulatory control architecture reduces plant settling time and peak offshoots, achieves faster disturbance rejection, and promotes higher power ramp-rates. In addition, improvements in IGCC coordinated plant-wide control strategies for "Gasifier-Lead", "GT-Lead" and "Plantwide" operation modes have been proposed and their responses compared. The paper is concluded with a brief discussion on the potential IGCC controller improvements resulting from using advanced process control, including model predictive control (MPC), as a supervisory control layer.