**Abstract for CRADA between Ames National Laboratory and NETL AGMT-0609**

The goal of this project is to develop a merged environment for simulation and analysis (MESA) at the National Energy Technology Laboratory's (NETL) Hybrid Performance (Hyper) project laboratory. The MESA sensor lab developed as a component of this research will provide a development platform for investigating

- advanced control strategies,
- testing and development of sensor hardware,
- various modeling in-the-loop algorithms, and
- other advanced computational algorithms for improved plant performance using sensors, real-time models, and complex systems tools.

The first step in the development of this facility was to integrate a visual and computational representation of the Hyper facility with the physical facility. This created a dynamic merged physical and computational environment (that included smart sensors and other components) capable of testing a broad range of control strategies.

Advanced power plants that utilize fossil fuel require higher efficiencies and lower emissions to provide for future power consumption needs while meeting higher regulatory standards. Hybrid power systems are a significant way to meet this challenge. However, many of the hybrid power systems being developed today include disparate components and systems that are tightly coupled together. This makes the control of these advanced power systems challenging. Current control strategies involve a hierarchical framework that utilizes a large number of sensors to collect data and then direct the action of a small number of actuators. Existing control strategies can be tuned for optimal performance within specific operating conditions but generally do not provide optimal performance during transients, or outside this operational window, they limit power plant efficiency. In addition, in some cases these tightly coupled hybrid systems can experience unstable transients that may be harmful to the system components. As the available computational power is increased at every level of the sensing and control system, control actions can be distributed and intelligent sensors can take a more active role in controlling the system. Advanced control strategies are needed that use embedded intelligence at the sensor and component level to make faster, more flexible decisions based on local information.

The goal of this project is to demonstrate various sensor placement and control strategies on a hybrid advanced power systems and to be able to compare conventional control strategies and novel advanced (e.g., biomimetic and other agent-based) sensor and controls strategies.