



Safe Integration of New Grid Technologies

INL offers unique simulation tools for creating new efficiencies

Application of human factors engineering in a simulated control room allows engineers to evaluate how operators interact with technology in ways that make the grid safer and more efficient.

Utility operators have a massive amount of information to monitor in a control room. The demands of modernizing the power grid and making it more efficient are only going to intensify the challenge in coming years.

Idaho National Laboratory is uniquely equipped to bring information from advanced grid technologies to system planners and control room operators in a manner that it can be easily used. From digital control room design to computer-based procedures for fieldworkers to dynamic line rating (DLR), which allows operators to use wind data to safely maximize transmission line capabilities, INL has developed simulation environments that can aid in the development of safer, more seamless management of utility assets.

HUMAN FACTORS

The Human System Simulation Laboratory (HSSL) at INL is a reconfigurable virtual control center created to safely test new technologies before they are implemented. While it has traditionally been used to simulate commercial nuclear reactor control rooms, the laboratory enables scientists to improve any control room design by creating an environment for studying human interactions with instruments and controls, both digital and analog.

An effective control room is one that minimizes distraction and reduces the need for operators to constantly shift their focus from panel to panel. Digital displays can condense information from several gauges into visual, at-a-glance overviews of what is happening in a process or

system. In training, real control room crews run scenarios, while cameras capture operator behavior for evaluation and integration into safer and more efficient processes.

DYNAMIC LINE RATING (DLR)

The more electric current a line carries the hotter it gets. Past a certain point, a line operator cannot allow additional power to flow without exceeding the thermal design limit of the conductor, which can cause elongation and sagging, mechanical failure, fault-induced outages, and danger to the public.

To avoid excessive sag or loss of strength, limits are usually placed on power flow based on worst-case weather conditions. These are called static ratings. Limits placed on power flow based on actual weather conditions are called dynamic ratings. By paying close attention to weather data, INL





researchers have discovered when the wind is blowing at increased speeds and a right angle to a high-voltage line, it can cool the line enough for a control room operator to safely increase the amount of current by 10 to 40 percent.

To perform such dynamic line ratings, engineers need accurate — real-time and forecast — information about environmental conditions and amount of current being carried on the line. INL's DLR team is piloting multiple projects. One with Idaho Power in southern Idaho involves sensors assessing wind and transmission line conditions and software that determines the maximum, yet safe and reliable, capacity of a transmission line in real time and predicted.

The end result is a system that provides planners and control room operators recommendations for action consistent with existing displays and presented in a way that's simple to process.

UNIQUE CAPABILITIES

With the electric industry under pressure to cope with unforeseen demands, an efficient, sustainable electrical grid is essential to a better quality of life. With its distinctive body of institutional knowledge and singular reputation for applied science, INL is proud to be engaged in the mission of ensuring the nation's energy security with safe, competitive and sustainable systems.

FOR MORE INFORMATION

Technical contact

Jake P. Gentle

208-526-1753

jake.gentle@inl.gov

General contact

Abby Todd

communications liaison

208-526-6166

abby.toddbloxham@inl.gov

www.inl.gov



The Human System Simulation Laboratory at INL is a reconfigurable virtual control center used for operator training and research.

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