Introduction to Grid Management Systems

This is a computer-based training module which consists of several video lectures and simulation exercises. The instructor presents a lecture on the evolution of Energy Managements system starting with Analog AGC systems in 1950's, through first Digital AGC/SCADA systems in 1960's first generation EMS in 70's to 90's and second-generation systems in 2000's. The lecture also covers the evolution of master station to substation communications including first generation discrete component Remote Terminal Units (RTUs), second generation computer based RTUs and third generation distributed Intelligent Electronic Devices (IEDs). Grid management applications that are recommended by NERC for maintaining network reliability are also explained where they cover new reliability applications that consider system dynamic response and use PMU data. Some challenges in sharing models and upgrading legacy Energy Management Systems are also covered. The instructor lectures from the EPRI report on Grid Operating Systems 3.0. and covers power system changes such as: distributed generation, electric vehicles, increased renewables and distributed controls and how these changes are necessitating a new generation of Grid Monitoring, Control and Analysis Systems. The characteristics and behaviors of people with different levels of expertise from novice to expert or master are explained as well as the recognition primed decision model originally developed by Dr. Gary Kleni that has been adapted to describe how system operators develop situational awareness and make decisions. Students will learn the basic functionality of the power simulator features in this lecture as well as operate it with detailed step by step instructions and build a cranking path from a generator which has the capability to run back to house load after a system disturbance. After the secondary steam unit is synchronized, the student will add load in controlled steps to bring both units up to their minimum operating level while keep the frequency deviations within limits.

PALCO100 Course Objectives

Introduction to Grid Management Systems

COURSE CE HOURS		
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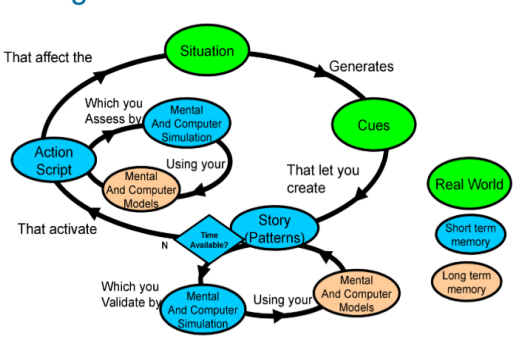
- Describe the evolution of Energy Management systems from the 1950's to present.
- Describe the evolution of master station to substation communications
- Operate the simulator on a power system model.
- Detect voltage violations and branch overloads on the system overview map.
- Start, stop and re-dispatch generation as well as monitor and control the load.
- Navigate between the wide area system map and the detail of station diagrams.
- Apply the make before break rule to take a substation bus out of service.
- List and describe the purpose of applications that are used for maintaining network reliability.
- Describe the next generation applications that consider system dynamic response and use PMU data.
- Describe challenges in sharing models and upgrading legacy Energy Management Systems.
- Describe how distributed generation, electric vehicles, increased renewables and distributed controls are changing tomorrow's power systems.
- Describe how these changes are necessitating a new generation of Grid Operating System.
- Operate the simulator to build a cranking path from a generator which has the capability to run back to house load after a system disturbance.
- Using the simulator, start and synchronize a secondary steam unit.
- List and describe the characteristics and behaviors of people with different levels of expertise from novice to expert or master.
- Draw a flow diagram of a process that can be used to describe how system operators develop situational awareness and make decisions.
- Operate the power system simulator to implement the steps to remove components from service.
- Locate reactive resources (shunt reactors, shunt capacitors, static VAR compensators, etc) in the system.
- Using the simulator, verify a switching order as correct or incorrect.
- Identify proper switchig protocols and good procedural practices.

Decision Making Challenges

Recognition Primed Decision Model



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