Powersmiths

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OPS-X Module Summary

The OPS-X Operations Training is structured in five modules providing 40 hours of NERC Continuing Education Units. The training meets the NERC Recommendation 6 (Compliance Template P8T3) requirements for System Emergency Training.

- ***Powersmiths International has developed NERC certified continuing education training for system operators based on the PowerWorld Simulator software***
- ***This training is highly simulator based and is targeted at the NERC System Emergency Training requirement and areas that are required under the new NERC System Operator credential program.***

OPS-X is offered with a satisfaction guarantee. If you are not satisfied with the training for any reason, we will work with you to address your concern. If we are unable to reasonably satisfy your concern, we will refund your money.

OPS-X

- ***The OPS-X training is structured in 5 training modules for a total of 40 NERC Continuing Education units***

- ***The modules are as follows:***

  - **AC Systems I and II (8 hours)**
    Power Flow
    Reactive Power
    Voltage Regulation
    Generation Control- NERC Standards BAL-001, BAL-005, BAL-006

  - **EHV Operations I and II (8 hours)**
    ACE concepts- Disturbance Control Standard- NERC Standard BAL-002
    Contingency Analysis- BAL-002
    Operating Reserves- BAL-002
    Reactive Reserves- NERC Standard VAR-001
    Contingency Reserves- BAL-002
    System Operating Limits (SOL) and Interconnection Reliability Operating Limits (IROL)- NERC Standards IRO-004, IRO-005

  - **Congestion Management (8 hours)**
    Economic dispatch and marginal cost generation
    Loop flows
    Transmission Loading Relief (TLR)
    NERC Standards IRO-004, IRO-005, IRO-006
    Available Transmission Capacity (ATC)
    Power Transfer Distribution Factor (PTDF)
    Interchange Distribution Calculator (IDC)

- **Power System Restoration (8 hours)**
  NERC Standards EOP-005, EOP-006, EOP-007
  A reference document by the NERC Operating Committee "Electric System Restoration."

- **Transmission System Operations (8 hours)**
  Relay action
    Overvoltage
    Undervoltage
    Differential
    Distance (Zones 1, 2 and 3)
  NERC Standards TOP-001, TOP-004, TOP-006, TOP-007, TOP-008. PRC-001, PRC-002
  System faults
  Transmission system relief
  Partial system restoration
  Transmission congestion

Expanded NERC Operator Certification Program

The expanded (2006)NERC Operator Certification program has the following requirements:

Reliability Operators—200 CEU's
Combined Transmission/Balancing and Interchange—160 CEU's
Transmission Operator-140 CEU's
Balancing and Interchange Operator—140 CEU's

30 CEU's must be on the NERC Standards and
30 CEU's must be achieved through some form of simulation exercise

Additionally, each transmission operating company has a requirement for 32 hours of Emergency Operations training

These are not additional requirements in that if the training course is properly structured it can meet more than one or all of these requirements

The following table shows how OPS-X meets the credential requirements.

OPS-X Module	NERC CEU's	Standards Hours	Simulation Hours	Emergency Ops Hours
AC Systems	8	2	7	8
EHV Ops	8	6	6	8
Congestion Management	8	4	6	8
Power System Restoration	8	4	5	8
Transmission System Operations	8	1	7	8
Totals	**40**	**17**	**31**	**40**

Module Description

Module I-**AC Systems**—8 NERC CEU's

Module I, **AC Systems**, presents the basics of AC power systems, Control Area operation, load and generation balance, ACE, NERC Standards BAL-001, BAL-005, and BAL-006, Disturbance Control Performance, voltage regulation, reactive power and real power flow, VAR generation, surge impedance loading and load and transmission line modeling.

Module I is divided into two parts. **AC Systems Part I** consists of Exercises 1-4. It demonstrates the principles of AC systems utilizing a system with two busses and two transmission lines. **AC Systems Part II** consists of Exercise 5 and 6 and demonstrates the principles of AC systems using a more complex system configuration with the addition of a third line and a third generator. Each part is concluded with an Evaluation Exercise to test the participants understanding of the concepts of that part of the module.

Module II-**EHV Operations**- 8 NERC CEU's

In this module, the topics of power flow, power transfer, reactive power transfer, real and reactive power reserves, contingency analyses, ACE, NERC Standard BAL-002, DCS, Operating Reserve, Reactive Reserves, NERC Standard VAR-001 and System Operating Limit (SOL) and Interconnection Reliability Operating Limit (IROL) with Standards IRO-004 and IRO-005 are addressed.

This module builds on the lessons of Module 1 particularly those related to voltage control and line loading. The power system is the same for consistency

Exercises 1-3 address contingency analysis for a single contingency and concentrate on operating the system so that an SOL/IROL is not violated in the no contingency state and that Operating Reserves are maintained. Also, the NERC DCS is revisited.

Exercises 4-6 concentrate on contingency analysis for a second contingency and reconfiguring the system so that an SOL/IROL is not violated following a first contingency and Operating Reserves are maintained.

Module III- **Congestion Management**- 8 NERC CEU's

In this module, the system has been expanded from that of Module II to include a third bus. Congestion exists on the system in that transmission line ratings limit the ability of the cheapest power to reach all of the load. The basics of economic dispatch and marginal cost generation are covered.

Also, scheduled power transactions create loop flows on the system that impair the ability to transfer power within the Control Area. Operators must configure the system so that ACE DCS is not violated, voltage profiles are maintained and lines are not overloaded. Transmission Loading Relief (TLR), Standards IRO-004, IRO-005 and IRO-006, Available Transmission Capacity (ATC), Power Transfer Distribution Factor (PTDF) and the Interchange Distribution Calculator (IDC) are discussed.

Module IV—**System Restoration-** 8 NERC CEU's

This module addresses the basics of re-establishing a power system from a blacked out state. It is based upon NERC Standard EOP-005, EOP-006 and EOP-007 and a reference document by the NERC Operating Committee "Electric System Restoration."

In this module, the operator is placed in an islanded and blacked out system. The requirement is to re-energize the transmission system, make generation available for synchronization and restore load.

The power system simulated is more extensive than that of the first three modules. An understanding of the basics presented in the first three modules is required.

Module V—**Tranmission System Operations**- 8 NERC CEU's

This module builds on the lessons of the four previous modules using the more extensive power system of Module IV. It addresses the following concepts of as well as the concepts of NERC Standards BAL-002, VAR-001 previously presented but this time in the context of a more complex power system. NERC Standards TOP-001, TOP-004, TOP-006, TOP-007, TOP-00, PRC-001 and PRC-002 are also presented

- Transmission congestion
- Transmission system relief
- Relay action
- System faults
- Partial system restoration

The operator is presented with a number of faults on the system.

In Exercise 1, undervoltage relays will act should voltage go lower than 0.95. Overvoltage relays will operate should voltage exceed 1.05 p.u. Should relays operate, the operator will need to isolate the critical areas and re-establish proper voltage to all buses. When proper voltage is restored, the operator may then close all lines and attempt to restore service to all buses.

In Exercises 2 and 3, faults are applied at varying locations on 138 kV lines. The faults must be isolated and service restored to as much load as possible. In some cases, load will be able to be restored to all buses, in other cases it will not depending upon fault location.

Fault location is determined by opening some line segments while re-closing others to see if the line section holds. In most cases the odds are 50/50 that you will re-close into the fault. If you do so, learn from it so that you do not do it again. The operator will be penalized for reclosing into faults so minimize the number of times that you do so.

Restore as much load as quickly as possible after each fault as a penalty will be assessed for load not served. When the fault is cleared (notification by a text message on the one-line diagram) reclose any open line segments as quickly as possible.

While managing the transmission system in response to faults the operator must also maintain ACE and dispatch generation as economically as possible while keeping lines from overloading.

In Exercise 4, the operator will be faced with faults on a different portion of the 138 kV system. These faults will initiate zone 1 and zone 3 distance relaying. By analyzing the relay zones one should be able to identify fault location and avoid reclosing into the fault.

If voltage is not managed carefully in this exercise it is also possible to initiate overvoltage relays which will significantly complicate the exercise.

Exercises

- Each OPS-X training module contains one or more simulator training Exercise (hence the X) with a narrative explaining the exercise fundamentals and objectives. In the Exercises, the operator will interact with the power system in faster than real-time to experience first hand, the concepts of the training topic.
- Some Exercises are static in time. In this case, conditions are not changing. The operator can make changes to the power system to determine their impact.
- Most Exercises are dynamic. Conditions are constantly changing and the operator must react to those changing conditions.
- A dynamic Exercise will serve as the final exam for each topic. The operator will be graded on his/her response to changing system conditions.

Exercise Scoring

In each exercise, you are placed in the role of system operator for your control area. Your control area is interconnected to one or more control areas which will respond automatically as necessary to balance generation and load.

As you proceed through each exercise, area generation costs, load, ACE, generator power and VAR outputs, bus voltages and line loadings are monitored and recorded.

The exercise is scored based upon how well you maintain these variables within acceptable operating boundaries and ratings. Usually it is easier to maintain operation within boundaries and ratings if more generation is on-line. Unfortunately, more generation on-line means higher generation costs. You will need to balance reliable operation and generation costs.

The scoring for each exercise is based upon the costs of area operation for that exercise. You are trying to minimize costs. Total score is:

- the sum of area generation costs
- costs for unscheduled power imported from adjoining control areas
- costs associated with VAR support from adjoining control areas
- penalties for ACE violations
- penalties for dropping load (either intentionally or due to low voltage)
- penalties for operating generators at their VAR limits (heating of generators reduces life time)
- penalties for low or high voltage at the buses
- penalties for operating the transmission lines above rating

Target scores are provided for each exercise. Achievement of the target score is an indication of that you have gained an excellent understanding of the concepts of the exercise.