SECTION C

ENERGY MANAGEMENT SYSTEM:

Requirement of EMS Functions.

- Why do we need EMS functions?
  - Help grid operators in decision making .
  - Gives scientific logic for any actions.
  - Gives warning for any emergency situation.
  - Power system can be analysed for different operating conditions.
  - To get a base case for further Analysis.

EMS functions objective

- Power system monitoring
- Power system control
- Power system economics
- Security assessment

EMS Functions : Classification Based on Function

1. State Estimation
2. Power Flow Analysis
3. Contingency Analysis
4. Security enhancement

What is Energy Management?

- Energy management is doing more with the same amount of energy or less energy.
- Energy management saves money and makes buildings more comfortable, healthy, and safe.

Benefits of Energy Management

- Reduces consumption
- Increases comfort & safety
- Reduces pollution
- Makes our economy stronger
- Increases our energy security

EMS Functions : Classification Based on Time Domain

- Pre Dispatch Functions
  - Load Forecasting/Inflow forecasting
  - Resource Scheduling And Commitment
  - Network Outage Planning
- Real Time Operation
  - State Estimator (RTNET)
  - Real Time contingency analysis (RTCA)
  - Real Time Security Enhancement (RTSENH)
  - Real Time Generation Control (RTGEN)
  - Voltage Var Dispatch
- Post Dispatch / off line activities
  - Dispatcher training Simulator
  - Other features like
  - Historical Data Recording,
  - Historical Information Management,
  - Sequence Of Events,
  - Load Flow Studies (STNET)

EMS Functions

- Out of the all EMS functions State Estimator is the first and most important function.
- All other EMS functions will work only when the State Estimator is running well.
- State Estimator gives the base case for further analysis.

Efficiency vs. Conservation

- Efficiency
- Energy efficiency involves the use of technology that requires less energy to perform the same function.
- Focuses on the equipment or machinery being used
- One example is installing LED light bulbs throughout the house
- Conservation
- Energy conservation includes any behavior that results in the use of less energy.
- Focuses on the behavior of people
- One example is using day lighting through windows rather than turning on the lights

Savings Opportunities: Electric Appliances

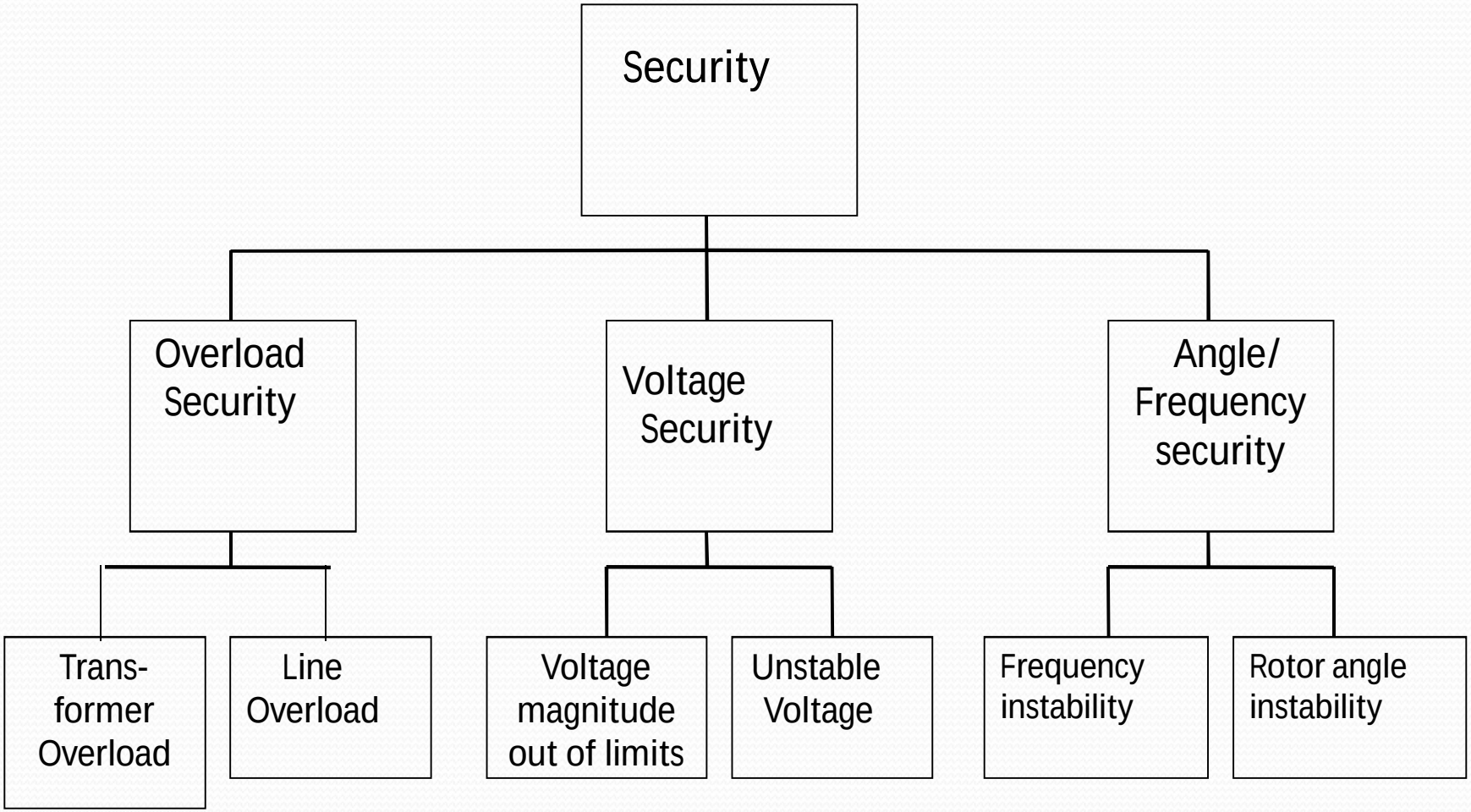
Monitors with Screen Savers

Power Saving Options Not Enabled

Security analysis

- Security is the ability of the electric systems to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements.

An operator's view of "security"



Another View of "Security"

Security = dynamic security

Adequacy = static security

This view is strongly held by engineers that have been deeply involved with "reliability"assessment tools for planning such as TRELLS, Tplan, etc., which compute probabilistic indices based on static security assessment. They will tell you that their tools are concerned with adequacy, not security.

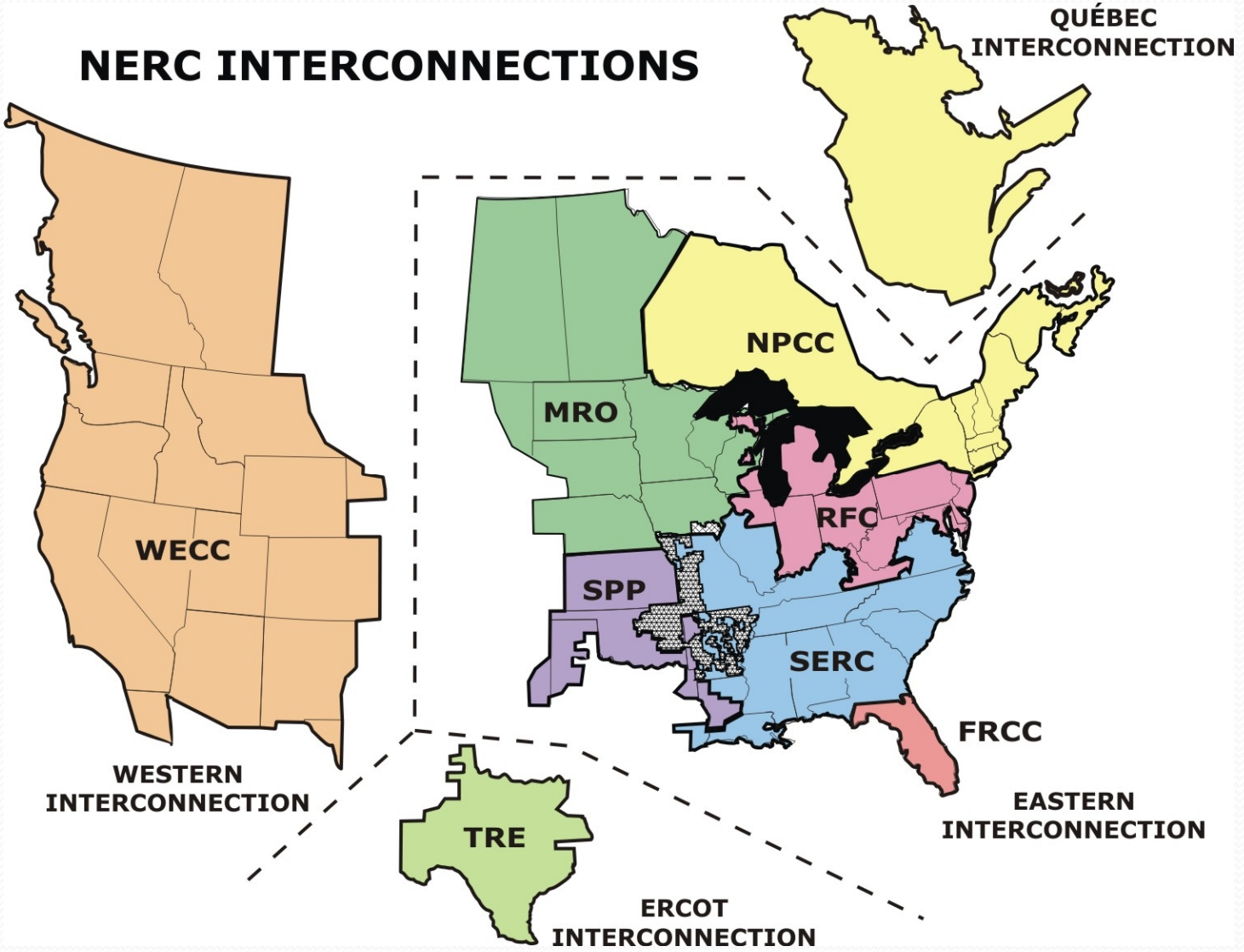
REQUIREMENTS OF A RELIABLE ELECTRIC POWER SERVICE

- Steady-state and transient voltages and frequency must be held within close tolerances
- Steady-state flows must be within circuit limits
- Synchronous generators must be kept running in parallel with adequate capacity to meet the load demand
- Maintain "integrity" of bulk power network: avoid cascading outages

NERC, North American Electric Reliability Corporation:

Mission is to ensure reliability of the bulk power system in North America. They develop/enforce reliability standards; assess reliability annually via 10-year and seasonal forecasts; monitor the bulk power system; evaluate users, owners, and operators for preparedness; and educate, train, and certify industry personnel. NERC is a self-regulated organization, subject to oversight by the U.S. Federal Energy Regulatory Commission & governmental authorities in Canada. It is composed of 9 regional reliability councils & encompasses virtually all power systems in US & Canada. NERC's activities play an essential role in preventing contingencies and mitigating their consequences.

Interconnections



HOW ARE RELIABILITY CRITERIA USED?

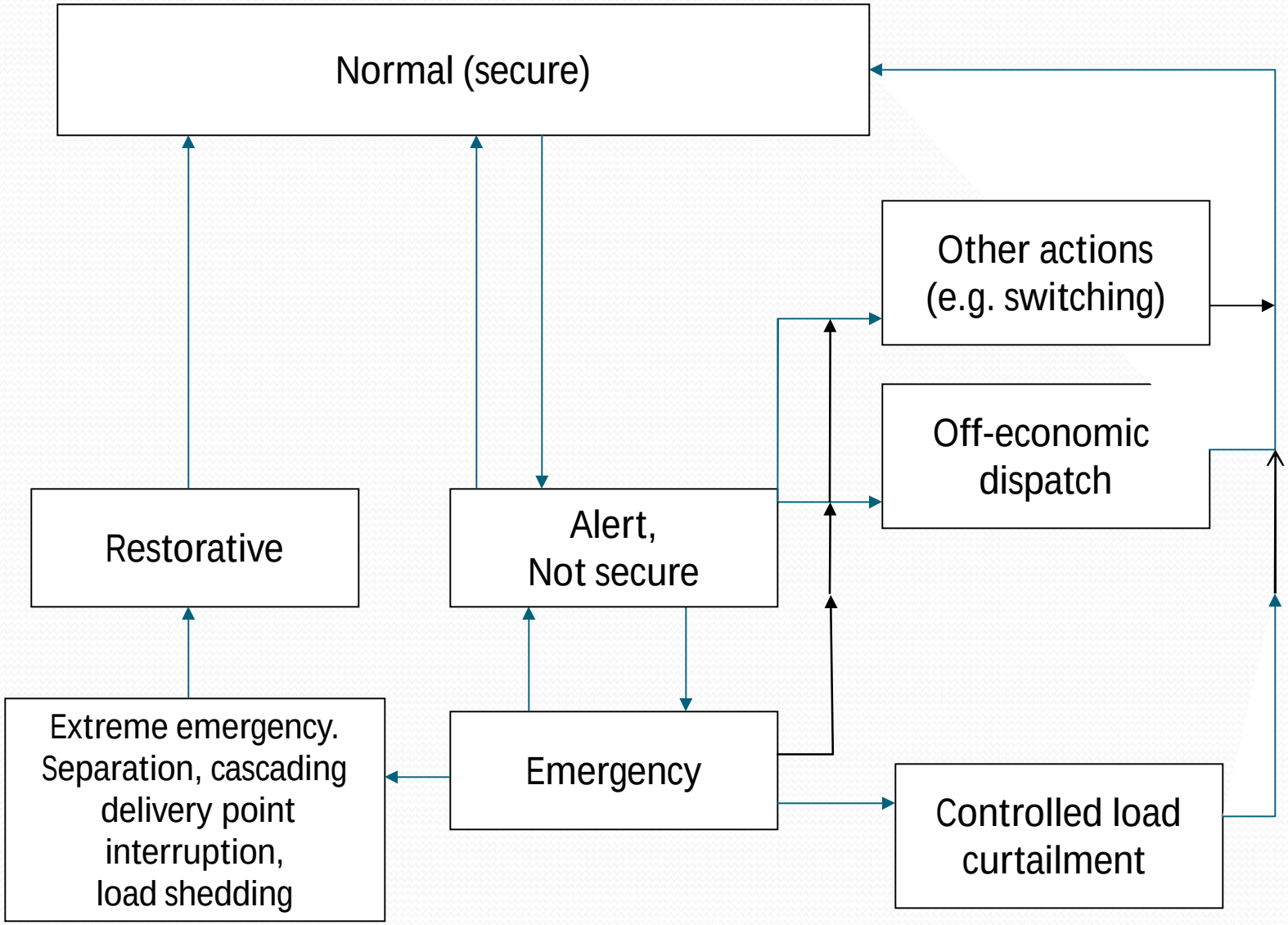
A) In System Planning or Design

- Make decisions on size, type and timing of new generation and transmission facilities
- Design transmission network to withstand normal & prescribed abnormal conditions
- The latter includes such things as short circuits (faults) followed by loss of major components (to isolate the fault).

B) In System Operation

- Establish most economic operating conditions under “normal” conditions
- Operate the system such that if an unscheduled event occurs, it does not result in violation of reliability criteria.
- Establish “Safe Operating Limits” for all situations

Power system operational "states" & actions (given with respect to credible contingency list)



Some comments about the previous slide:

- The use of criteria ensures (and the diagram illustrates that), for all **credible** contingencies, the system will, at worst transit from the normal state to the alert state, rather than to a more severe state such as the emergency state or the *in extremis* state.
- If a system is operated according to criteria, the system can transition from normal state to emergency or *in extremis* state only for a non-credible (extreme) contingency.
- When the alert state is entered following a contingency, operators can take actions to return the system to the normal state, but such actions should not include load shedding.
- Load shedding should only be performed under emergencies.