Operation of Electric Power Systems
Chapter 1: Overview of technical and economic operation of PS (Part IV)

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Basic technical characteristics and functions

Content

• Part I: Introduction and basic concepts
  • The role of electric power systems in economy
  • The need to transport the electricity: a global perspective
  • The particular characteristics of electricity
  • Activities involved by the electricity sector

• Part II: Historic evolution
  • Historic evolution of technical aspects and demand
  • How can be the sector organized?

• Part III: Basic characteristics and technical aspects
  • Consumption
  • Generation
  • Transmission
  • Distribution
  • Control and protection of power systems

• Part IV: Two regulatory/management paradigms
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Managements of power systems
Two paradigms

• Two regulatory paradigms
  • Centralized – traditional
  • Descentralized – liberalized

• Two alternatives to manage the activities of the sector to reach a common objective: maximize efficiency
Managements of power systems
Centralized context

• Vertical integrated geographical monopolies
  • Centralized expansion and operation
  • Cost minimization

• Cost of service regulation
  • Guarantee to recover costs
    • Fixed investment costs
    • Variable costs
  • Tariff to clients with an obligation to supply (with certain standards)
    • The risk is born by consumers
Managements of power systems
Liberalized context

• Generation and retail activities are liberalized and decentralized (network business is a natural monopoly)
  • Decisions are freely taken by individual agents
    • Investment (can attract private and foreign investors)
    • Operation

• Competition can give incentives
  • Generation
    • To efficiency and innovation
    • To provide a “fair” remuneration
  • Retail
    • Provide efficient services to the demand
  • Demand
    • Play an active role
Managements of power systems
Liberalized context: generation

• Generators’ objective is to maximize benefit

• Market mechanisms for generation
  • Short-term markets led by market forces
    • Supply and demand equilibrium sets the ST price
  • Long term markets to hedge risk

• Investment recovery is not guaranteed

• In a perfect competitive context (we shall see it in chapter 4) the market equilibrium leads to the cost minimizing solution
Managements of power systems
Liberalized context: retail

• Unbundling between network and retail
• Added value to the client
  • New products (tariffs)

• Full regulated tariffs need to disappear, but access-tariffs remain necessary to recover regulated costs.
  • Vulnerable customers might be an exception
Managements of power systems
Centralized long term expansion

• Centralized planning taking into account interactions among:
  • Network expansion
    • Security criteria
  • Generation expansion
    • Minimum cost and security criteria
  • Environmental and strategic policies

• Accounting for shorter term planning decisions
  • Short-term operation
  • Very short-term operation
Managements of power systems
Liberalized long term expansion

• Generation
  • Objective: maximize profit
  • Estimation of future market behavior

• Network
  • Objective: avoid inefficient network constraints
  • Imperfect information as regards generation expansion
  • Can be centralized or partially de-centralized

• Regulator
  • Long-term strategies
  • Externalities
Managements of power systems
Medium and short-term operation

• Centralized: decisions based on the information (demand, price of fuels, etc.), expectations & risk aversion of one entity
  • Medium term:
    • Contracts, stocks and maintenances
    • Hydro plants medium term strategy
  • Short term
    • Unit commitment (start up and shut down)
    • Coordination of plants in the short term

• Liberalized: different agents
  • Based on market expectations (competitors strategies)
    • Make planning decisions
    • Bid in the different markets
Managements of power systems
Real time operation

Centralized
First, the SO ensures enough resources to guarantee security in the real time

- Telemetry
- Data Base Real Time
- Consistent data & state estimation
- Analysis

Control (Automatic or manual)

Liberalized
- Similar process but the resources to ensure security can be procured in markets
- Ancillary services:
  - Frequency regulation service (control frecuencia-potencia)
    - Primary
    - Secondary
    - Tertiary
  - Voltage control (control de tensiones)
  - Black start (arranque autógeno)