



COMILLAS
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ICAI

ICAI – Master Ingeniería industrial (MII)

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**

Decision	Timeframe
Protection control	Real time (s)
Economic dispatch	Very short term (m)
Unit-commitment	Short term (h, d, 1 week)
Hydrothermal coordination	Medium term (month, 2-3 years)
Preventive maintenance	Medium term (month, 2-3 years)
Fuel management	Medium term (month, 2-3 years)
Expansion	Long term (2-3 years, 15 years)

Managements of power systems

Two paradigms

- Two regulatory paradigms
 - Centralized – traditional
 - Decentralized – 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

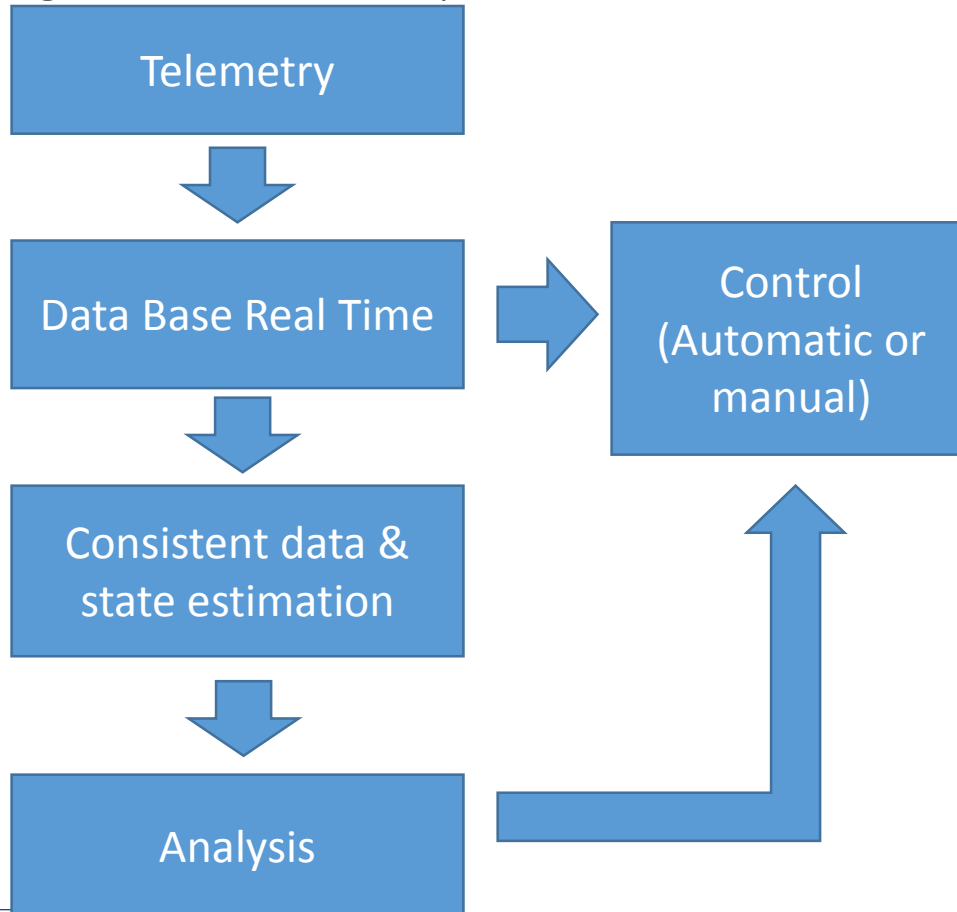
- Centralized: decisions based on the information (demand, price of fuels, etc.) , expectations & risk aversion of one entity
 - Medium term:
 - Contracts, stocks and maintenances
 - Hydro plants medium term strategy
 - Short term
 - Unit commitment (start up and shut down)
 - Coordination of plants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



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)