



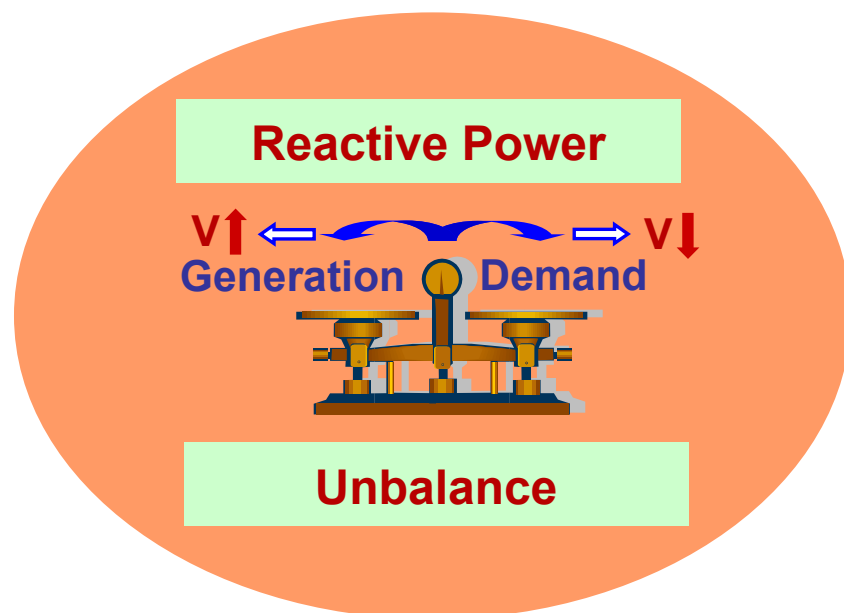
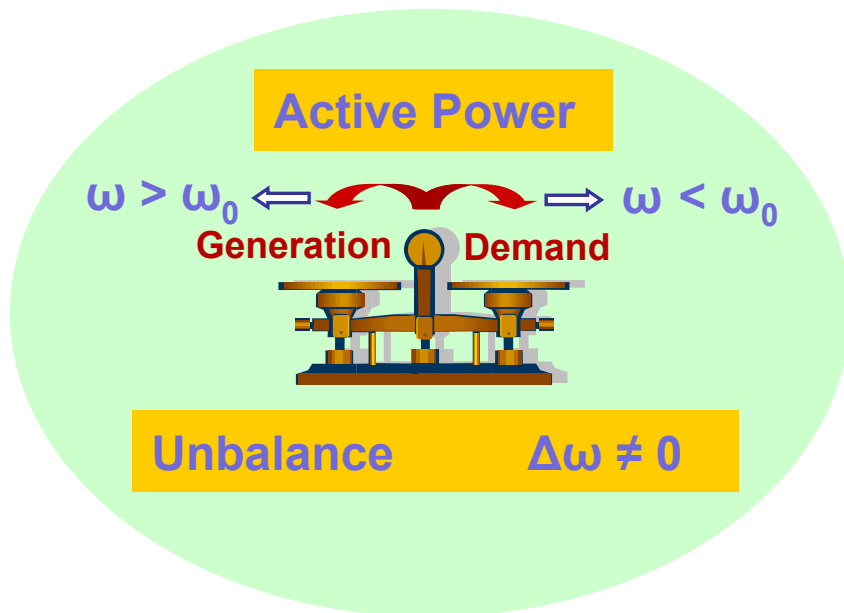
RED ELÉCTRICA
DE ESPAÑA

**DEMAND SIDE MEASURES
AND SECURITY OF SUPPLY**

May, 2005



System Operator Continuous Concerns



Local Level: Power swings; overloads

Global Level: System Collapse

Short Operating Time

Automatic means

Local Level: Voltage Dips

Global Level: Voltage Collapse

Moderate Operating Time

Auto/Manual Means



Demand accounting in different time frames

PLANNING PROCESS

- ❑ Forecasting activities and situations with demand contribution
- ❑ Administrative design (Market options, Contractual opportunities, Tariffs)
- ❑ Technical design (Dispatching, Communication and Control Systems...)

OPERATION PLANNING

Demand forecasting

BALANCING



PROCESS

Generation

**CONTINGENCY
ANALYSIS
(Generation & Grid)**

Market/Tariffs

**Actions
Scheduling**

REAL TIME PROCESS

Balance deviations

Generator outages

Major faults

Network failures

Scheduled actions

Automatic measures

Load shedding

$t = 0$

Time



Demand Control System Characteristics

Challenges for Demand Side Contribution

- **Fast, efficient and reliable communication system**
- **Sparse and Distributed Demand Problem**
- **Full knowledge of real available power and response times**
- **Reliability of demand control system response**
- **Checking, measuring and accounting facilities**



Present Demand Side Options in the Spanish System

TARIFF SYSTEM CLIENTS

- ❑ *Hourly Power Tariff (THP)*
- ❑ *Load Interruption Contracts (INTP)*
- ❑ *Active/Reactive Power Exchange*

FREE MARKET CLIENTS

- ❑ *Access to network reduced Tariff (6.5C)*

- *Distribution Operator manual load shedding of reduced zones*
- *Automatic under frequency load shedding*

Legal Frame

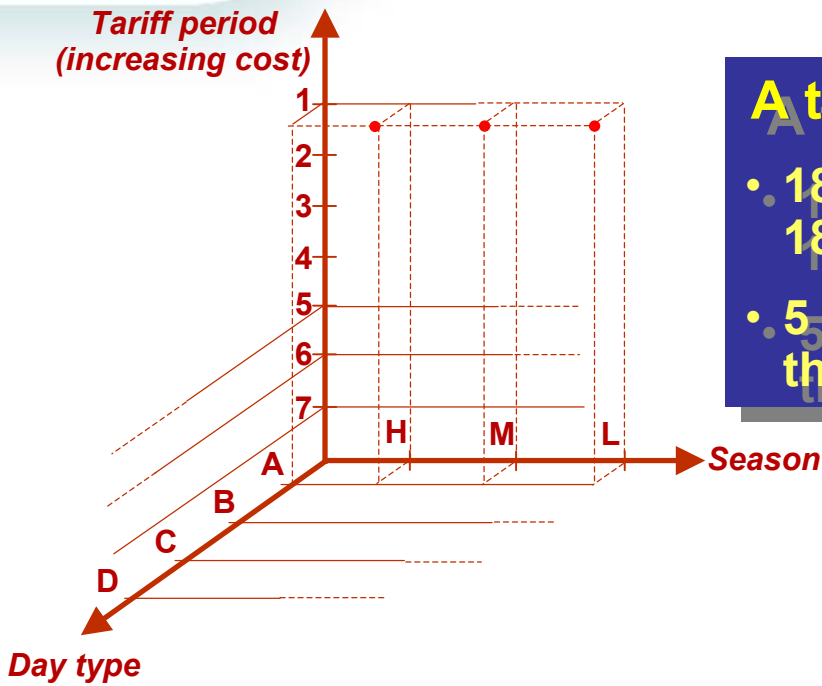
- *Real Decreto de Tarifas R.D. 2392/2004 por el que se establece la tarifa eléctrica*
- *Orden MIE de 12 de enero de 1995 por la que se establecen las tarifas eléctricas*
- *Resolución D.G.P.E. y M. de 28 de julio de 2004 por la que se aprueba el nuevo...*
- *Procedimiento de Operación 6.1*



Tarifa Horaria de Potencia (Hourly Power Tariff) THP

A total of 23 type A days/year fixed by TSO

- 18 days, weekly scheduled, notified before 18h of previous Friday, 6 weeks at most
- 5 days, daily scheduled, notified before 18h the day ahead

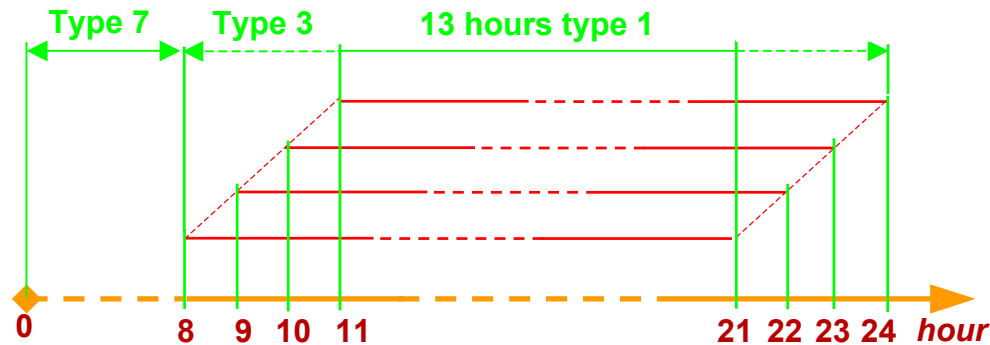


$$\text{Tariff} = \sum_{i=1}^{i=7} (t_{p_i} * P_{C_i} + t_{E_i} * E_i)$$

+ Reactive Compl. + INTP Compl.

$$t_{p1} / t_{p7} \approx 3,25; t_{E1} / t_{E7} \approx 9,6$$

Tariff periods along an A type day



Conditions: $\exists i; t_{p_i} \geq 20 \text{ MW} \cap \forall i; t_{p_i} \geq 5 \text{ MW}$



Load interruption contracts (INTP)

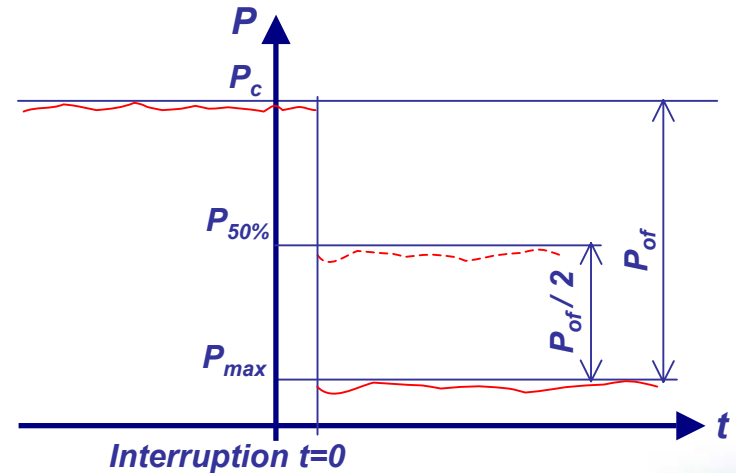
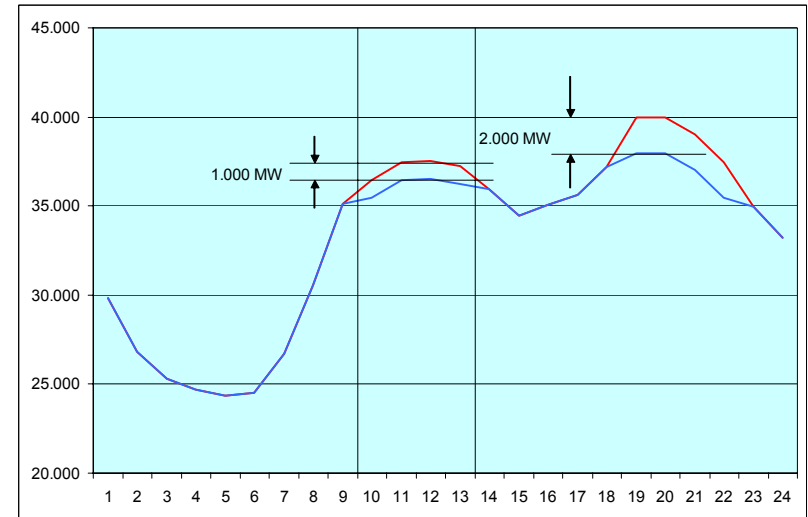
CONTRACT MAIN ISSUES

- ❑ Tariff
- ❑ Billing mode
- ❑ Power signed up for each period, P_c
- ❑ Hourly discrimination mode
- ❑ Interruption types chosen, from table below
- ❑ Next year energy consumption forecast
- ❑ Offered power, P_{of}
- ❑ Maximum power under interruption, P_{max} , $P_{50\%}$

Maximum number of interruptions

- ❑ 30 per year, no matter the type
- ❑ 5 per week, “ “ “
- ❑ 1 per day, “ “ “
- ❑ 240 h per year, total interruption time

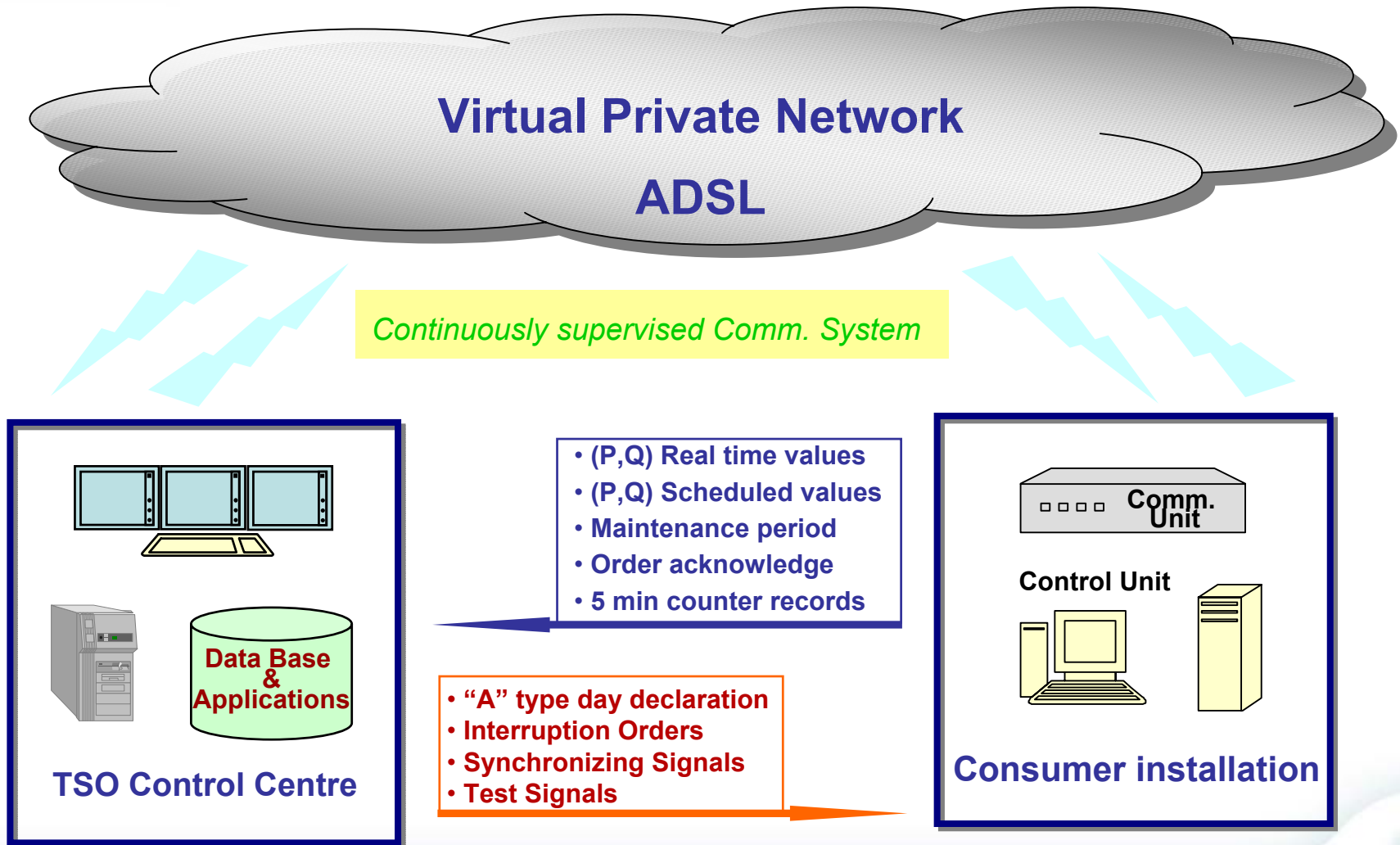
Type	A	A _{flex}	B	B _{flex}	C	D
Warning time	16 h	2 h	6 h	2 h	1 h	5 min
Duration	12 h	2 * 4 h	6 h	2 * 3 h	3 h	45 min
Change of conditions	No	till 1 h	No	till 1 h	No	No
Power reduction	P_{of}	$P_{of} \rightarrow P_{of} / 2$	P_{of}	$P_{of} \rightarrow P_{of} / 2$	P_{of}	P_{of}



Power definitions



Load interruption communication system





6.5 C network access tariff

Initially established by the Administration to favour Intnl. Energy Exchanges

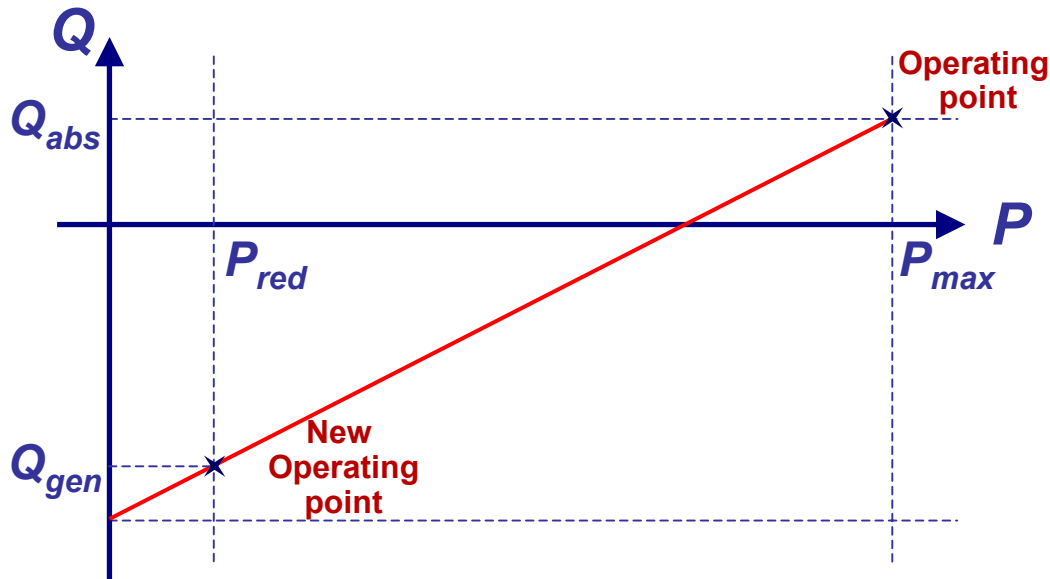
CONDITIONS

- ❑ Signed agreement: Client ↔ TSO ↔ Distributor
- ❑ Annual energy consumption in period 6 (off peak hours) ≥ 50 GWh
- ❑ Client's reactive power compensation means at TSO/Distributor disposal
- ❑ Dedicated 81m load shedding relays with specific settings
- ❑ Commitment to change voltage level grid connection upon TSO requirement



Operation Procedure 6.1: “Q → P Exchange”

- ▣ For clients with load interruption contracts
- ▣ Subject to client acceptance
- ▣ For reduced zones with foreseeable reactive power unbalance
- ▣ Personalized appointment and agreement by phone





Operation Procedure 6.1: Zone Load Shedding

- ❑ **Last manual survival measure of TSO**
- ❑ **Predefined selected distribution zones**
- ❑ **Rotary procedure for switching off different clients each time**
- ❑ **Zone load to be shed defined by TSO; selected by Distributors**
- ❑ **Permanently kept alive plans**
- ❑ **Until now, without economic compensation for consumers**



Automatic load shedding

