

The ancillary services

Dispatching users: Utente di dispacciamento (UDD)

- The Dispatching users are:
 - holders of generating units
 - holders of consumption units
 - Acquirente unico
 - holders of internal user networks and direct lines

Generating unit

- A production unit (Unità di produzione,UP) is constituted by one or more generation groups in the availability UDD, possibly grouped according to appropriate rules

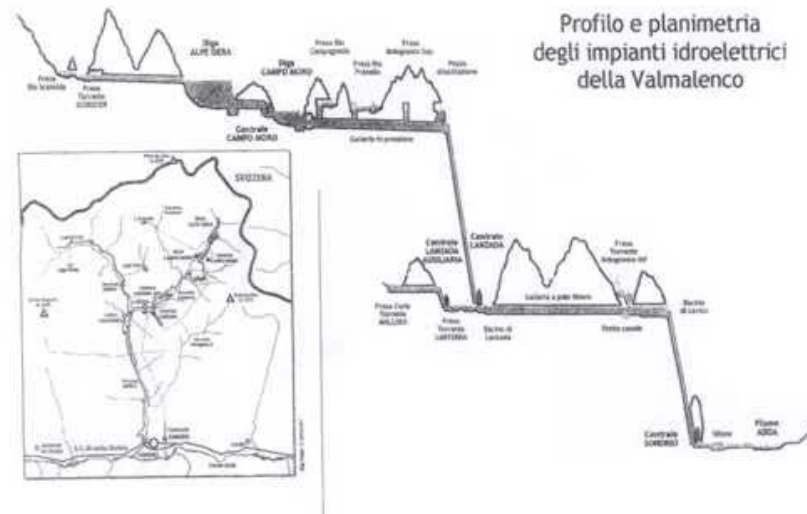
Aggregation rules

- **Generation groups not powered by renewable sources**
 - The set of groups of generating units whose total power is not greater than 50 MVA, belonging to the same generation plant, with the same primary energy sources and connected to the same grid point
 - Each generation unit with power greater than 50 MVA, with the following exceptions:
 - Repowered or CCGT generating unit, even if the individual elements are greater than 50 MVA
 - The set of the generation units that are functionally related to the same production cycle, even if the power is greater than 50 MVA, as approved by the TSO at the time of enrollment in the RUP (Registro Unità di Produzione, Register Production Units)

Aggregation rules

- **Generation units powered by renewable energy sources and cogeneration units**
 - **The set of generation groups belonging to the same generation plant:**
 - hydroelectric
 - renewable energy primary source
 - CHP

if its production is attributable to a same primary energy source , the same type (programmable / no programmable) and to a single connection grid point
 - **The set of hydroelectric generation groups belonging to the same basin, aggregates provided that, only if shifting production between the groups of the basin, there are not congestions in the grid.**



Relevant Production Units

- UP with nominal power equal to or higher than 10 MVA
- The relevant UP should take the necessary devices to ensure their integration in the control systems of TSO

Virtual Units

- **Generating Virtual Units: aggregation of non relevant PU, owned by the same UdD, belonging to the same area and the same type**
- **Import and Export unit**

Dispatching point for PU

- *Grid connection point for the relevant PU is the electric station where the power is injected in the network.*

Relevant Period

- **1 h for the PU not qualified to participate to the Ancillary Services Market**
- **For qualified PU is 15 minutes**

Load Units

- The Load Units are non relevant

Dispatching point for LU

- It is the set of one or more withdrawal points located in the same market zone and included in the transmission service contract signed between the UdD and TSO

Relevant Period of LU

- 1 h

Ancillary Services

- Purpose of *Ancillary Services*
 - Resources used for the security management of the electrical system and to ensure the quality of the service
- *Ancillary Services*
 - *Ancillary service for congestion management*
 - *Primary reserve*
 - *Secondary reserve*
 - *tertiary reserve*
 - *Balance reserve*
 - *Pump service*
 - *Reactive reserve*
 - *interruptible load*
 - *load rejection*
 - *participation in the restoration*
 - *availability to use the remote tripping*

Demand forecast

- Necessary for the (operational) planning
 - to reduce as much as possible uncertainties, reduce both (building) and scheduling of unnecessary generation capacity
 - To plan maintenance
 - To run continuously vs stopping and restarting
- Demand is fairly predictable because it is cyclic
- Load profile is different for every country or part of the country
- It depends on
 - Time of the day, of the week, of the year (seasonality)
 - Weather
 - Special events (sports, strikes, etc.)

Demand forecasting

- The TSO makes the daily load forecast of every 15 minutes
- The forecast includes losses on the transmission network (EHV system) and sub transmission network (HV system)
- The load forecast is carried out not only for the whole electrical system, but also for each geographical market zones
- Starting from the power load forecast, the energy load forecast for each hour is calculated as the integral of the power

Congestion management resources

- Goals
 - They are used to eliminate congestion on the EHV network
 - Who offers this service is willing to accept changes, up or down, to its updated cumulative programs

Who is authorized to provide the service?

- Per le unità idroelettriche, il rapporto tra l'energia che può essere erogata in una giornata e la potenza massima dell'unità è almeno pari a 4 ore
- The relevant PU that:
 - are connected to the National Transmission System
 - not belong to the following categories:
 - UP powered by non-programmable renewable energy sources,
 - UP functionally related to a production cycles, (cogeneration unit included), if the UdD declares the impossibility to modulate the unit production
 - CIP 6/92 PU, if the convention in place does not allow to modulate the production
 - UP in testing
 - are able to increase or decrease its power at least 10 MW within 15 minutes
 - For hydroelectric units with the ratio between the energy that can be produced in a day and the maximum power of the unit equal to or higher than 4 hours

When the TSO procures these resources?

- The TSO procures these resources simultaneously to the definition of the binding programs
- These resources are traded in the MSD

What are the obligations for the subject entitled to provide the service?

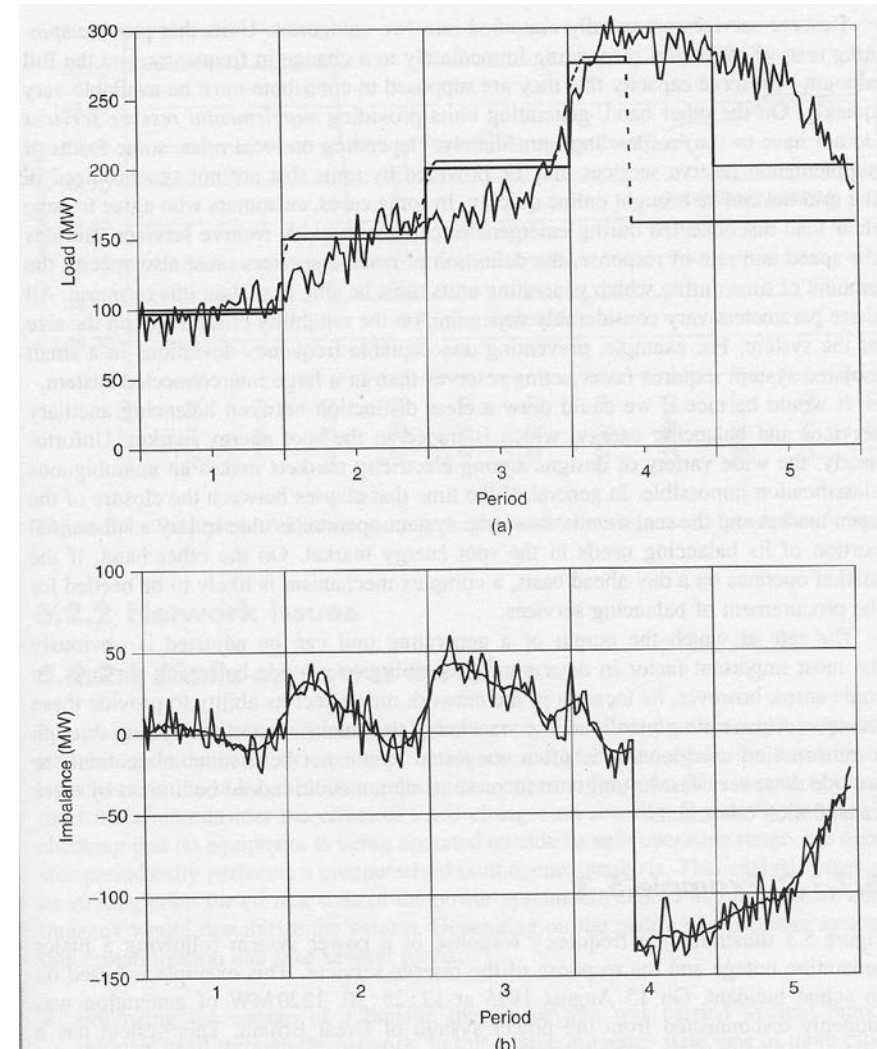
- Make fully and exclusively available the PU to the TSO:
 - The TSO can set the power output of the unit at any value between the minimum and maximum limits
 - Eventually, the unit can be turn off
- Notify the TSO any temporary changes in their technical data and unavailability of the balancing service
- Submit a bid in the MSD

Primary reserve

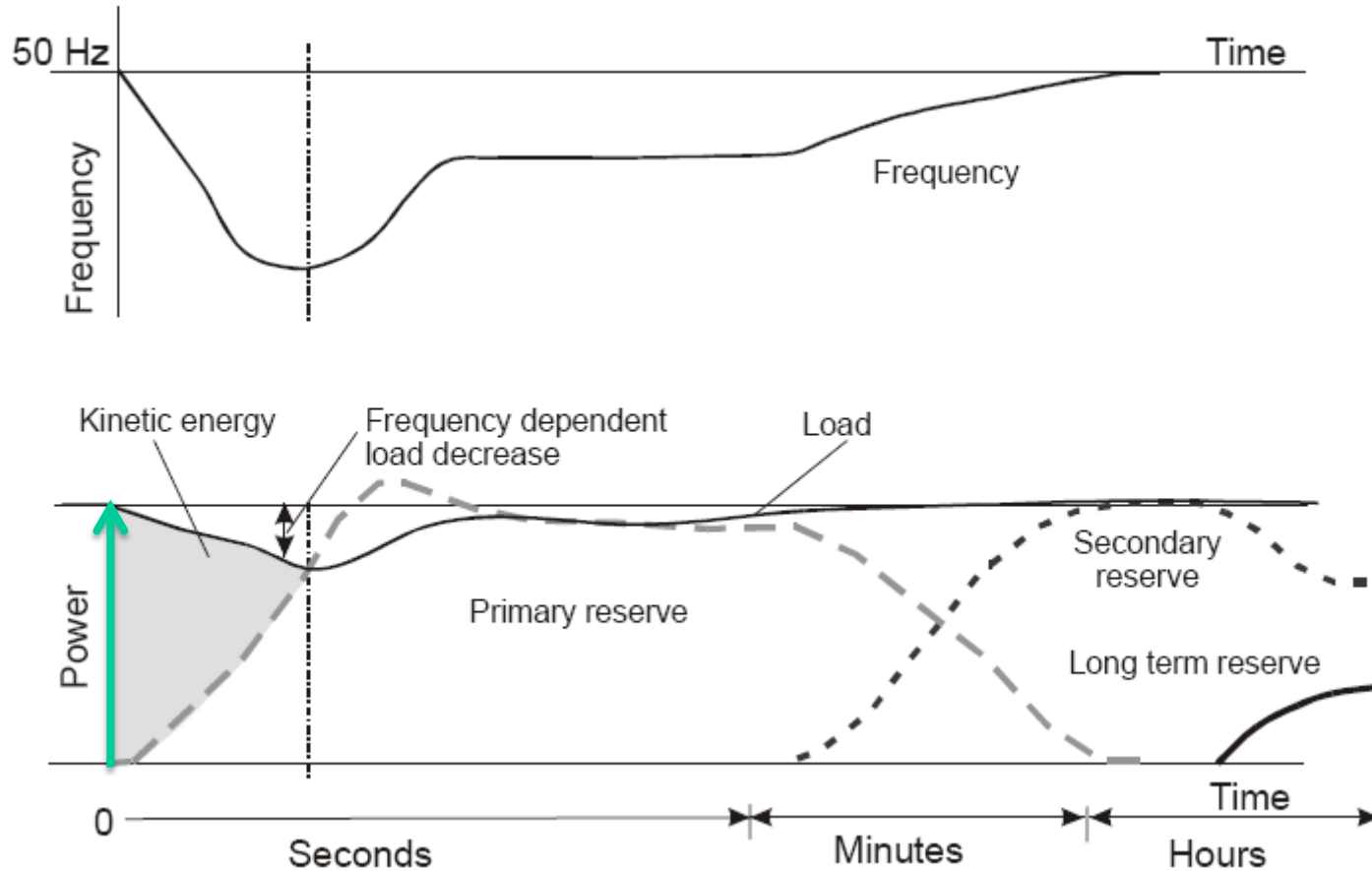
- **Goals**
 - It is used to automatically correct the imbalances between instantaneous total production and total load of the whole European electricity system
 - It is activated simultaneously by all the generating units in operation connected to the European electric system
 - Must be continuously available and must be distributed within the electrical system as evenly as possible
 - It consists in making available a power capacity bandwidth under the control of an automatic device able to modulate the power produced in case of a frequency variation

Frequency control and market schedule

- Load behaviour:
 - Small and random variations
 - Possible small and large perturbations
- Differences between the market schedule and the actual balance:
 - In terms of energy
 - In terms of power
 - Taking into account dynamic behaviour of generators (ramp rate, for example)

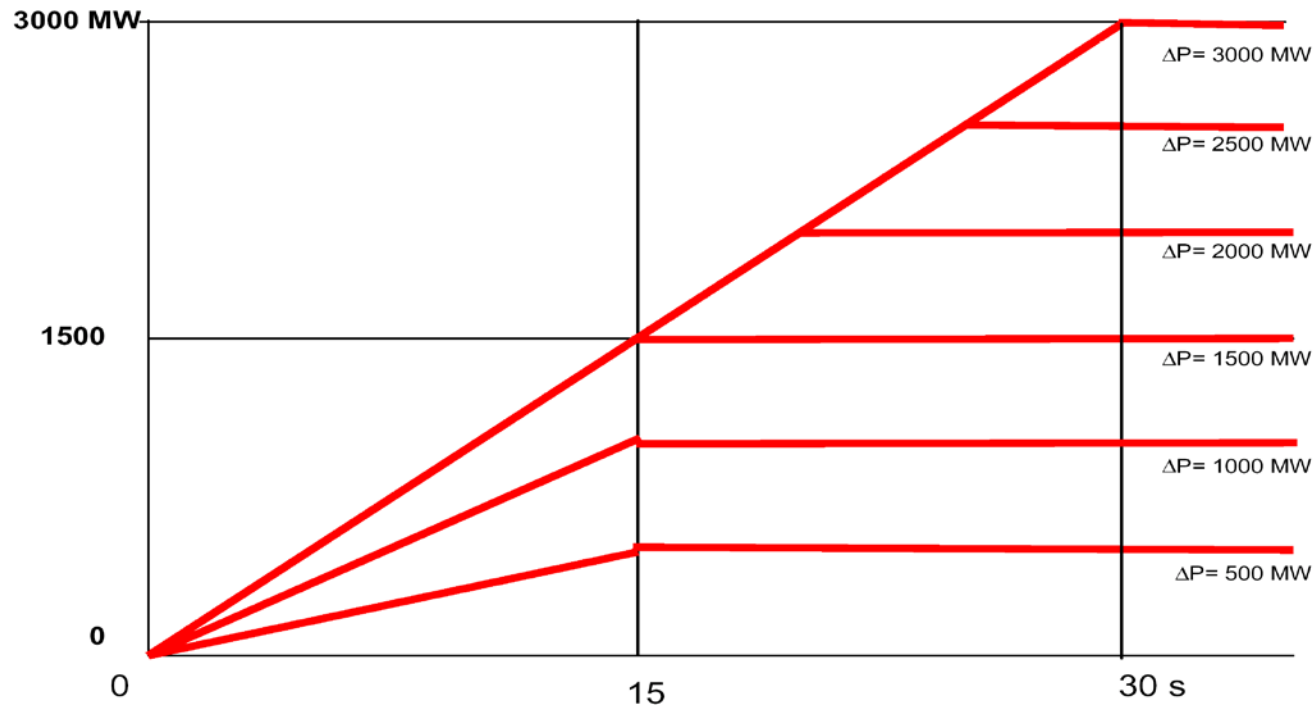


Frequency control (load dependent)



Primary frequency control in the ENTSO-E

- Normal variations of frequency are in the range ± 15 mHz, facing a 3000 MW incident
- The frequency regulation effect must be sustained for at least 15 minutes



Who is authorized to provide the service?

- **Provided by all PU with rated power greater than 10 MVA except those having a capacity regulating lack**
- **Example**
 - **Generating units powered by renewable sources not programmable**
 - **Geothermal units**

What are the obligations for the subject entitled to provide the service?

- In the Sardinia zone, the UdD must make available a power band not less than $\pm 10\%$ of the efficient power of each group belonging to the PU
- In other areas, the UdD must make available a power band not less than $\pm 1.5\%$ of the efficient power of each group belonging to the P
- In Sicily area, the band is band not less than $\pm 10\%$ power efficiency of each generation unit belonging to the PU if the interconnection cable with continental Italy is out of service
- The service is mandatory and paid but it is not trade in the MSD

And who does not eligible to provide the service?

- Le **UP** non idonee e quelle idonee ma **temporaneamente non in grado di rispettare l'obbligo di fornitura**, sono tenute al versamento del contributo sostitutivo, definito dall'**Autorità**, su proposta del **Gestore**
- The UP that are not eligible to provide the service must a fee, defined by the Authority

Secondary reserve for f-P control

- Goals:
 - To restore the rated value of frequency
 - To restore the scheduled values of the energy exchanges among control areas
 - Time scale: from 30s to 15 minutes
- In the **operating planning stage**, the PU is available to provide the half-band reserve or it is available to change its production in order to make the half-band reserve available
- In **real time**, to put the secondary reserve band under the control of an automatic device able to modulate the electrical power produced as a function of the Signal of Level sent by the TSO

Who is authorized to provide the service?

- The UP eligible to provide resources for the **tertiary reserve** are also enabled to provide secondary reserve power if:
 - at least one group of PU "Partecipazione alla regolazione di frequenza e frequenza/potenza"
 - the unit is equipped with a special processing apparatus of the level signal transmitted by the TSO
 - the unit provides the TSO the remote signaling about the state of the secondary regulation
 - U_dD of the PU has indicated in the RPU at least a band for secondary reserve greater than the minimum quantity defined by the TSO:
 - $\pm 15\%$ of the maximum power, for hydroelectric units
 - the greater of ± 10 MW and $\pm 6\%$ of the maximum power, for thermal power units

How does the TSO procure this service?

- This service is traded in the MSD

What are the obligations for the subject entitled to provide the service?

- Make exclusively available to the TSO the secondary power reserve
- Notify the TSO any temporary unavailability or variations regarding the service of secondary reserve
- In real time,
 - the secondary reserve band is under the control of an automatic device if this band has been selected in the ex-ante MSD
 - If the secondary reserve band has not been selected in the ex-ante MSD, put it under the control of the automatic device, if requested (in real time) by the TSO
- The TSO shall inform the Udd of PU selected for the secondary reserve about the quantity of the secondary reserve band assigned

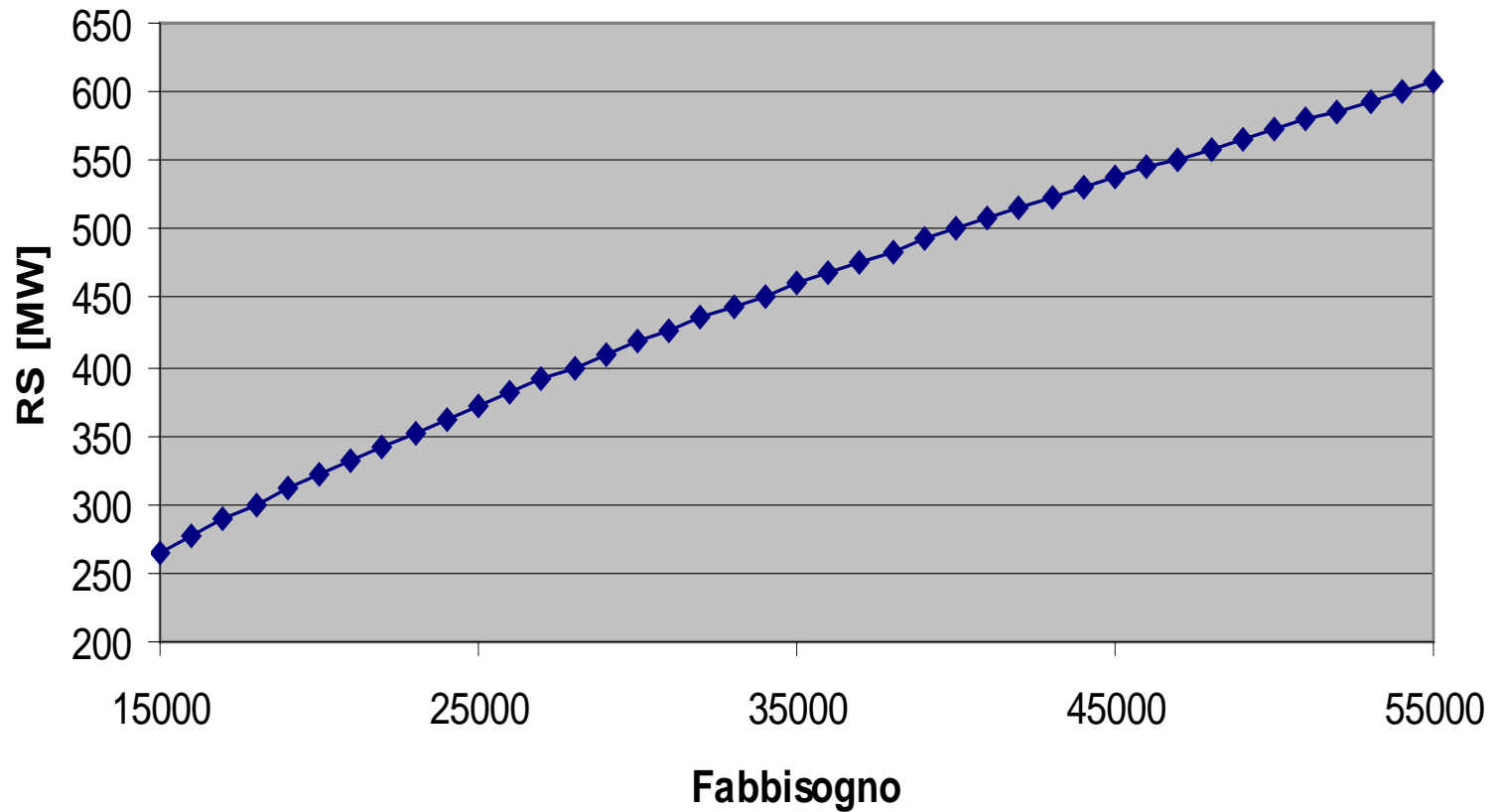
The total half-band for the secondary service

- For each hour, it is defined for
 - Continental Italy,
 - Sicily,
 - Sardiniain according to the following equation:

$$R_{\text{secondaria}} = -150 + \sqrt{150^2 + 10 \cdot C} \text{ MW}$$

where C è load in MW for each hour respectively for continental Italy, Sicily and Sardinia

Fabbisogno riserva secondaria



Tertiary reserve

- **Goals**
 - In the operational planning phase, it is used to establish appropriate margins with respect to the minimum and the maximum power
 - It is possible to activate the use of these margins in real time by sending dispatching orders (balancing service).
 - These margins are activated manually: they are not under an automatic control system
- **Due tipi di riserva:**
 - Up reserve
 - Down reserve

Tertiary up (down) reserve

- The tertiary up (down) reserve power consists in margin that it is possible to use **in real time** for increasing (decreasing) the power produced by the **PU with a pre-defined activation time defined by the TSO**
- The tertiary up (down) reserve power is given by:
 - PU in parallel with the network but not producing the maximum (minimum) power ($P_{\max} - P - P_{\min}$);
 - PA able to synchronize (shut down) with the network in a pre-defined time

Up (down) reserve

- Ready Reserve, made up by the increase (decrease) of production that can be injected (withdrawn) in the network within 15 minutes after the request of the TSO
 - This reserve is used to replenish the secondary band and keep the system balanced in case of rapid changes in demand (for example, ramp conditions) with speed requirements and continuity.
- Replacement Reserve: it is constituted by the increase (decrease) of production that can be injected (withdrawn) in the network, at the request of the Manager, from production units in service and that can be sustained indefinitely.
 - This reserve has the purpose to reconstitute the tertiary ready reserve in front of deviations of the loads, deviation of the production of non programmable renewable sources, failures in the production groups

How this service is provided

- La fornitura di risorse ai fini della **riserva terziaria di potenza** consiste:
 - nel rendere autonomamente disponibili margini rispetto alla potenza massima o minima nei **programmi aggiornati cumulati** delle **unità abilitate**
 - nella disponibilità ad accettare modifiche ai **programmi aggiornati cumulati** dell'**unità abilitata** allo scopo di costituire margini di **riserva terziaria di potenza**
- The provider of tertiary reserve power makes its available margins of the PU under the control of the TSO
 - The UdD is willing to accept changes to the power produced by the unit in order to constitute reserve margins

Who is authorized to provide the service?

- The relevant UP that:
 - must be connected to the transmission system
 - not belong to the following categories:
 - PU powered by non-programmable renewable energy sources;
 - PU functionally related to production cycles, (including cogeneration), if the UdD attests to the TSO the inability to modulate the power produced
 - PU CIP 6/92
 - PU in testing
 - are able to begin to change, increase or decrease, the power within 5 minutes after the TSO request (dispatching order), if they are already synchronized with the network
 - are able to vary, increase or decrease, the power at least 10 MW within 15 minutes from the arrival of a dispatching order
 - limited to hydroelectric units, the ratio of the energy that can be produced in a day and the maximum power of the unit is at least 4 hours;
 - the physical control center of the unit is manned and capable of performing dispatching orders 24 hours 24 and 7 days on 7

Other criteria for the ready reserve

- They are able to increase (decrease) its input with a gradient of at least 50 MW/min

How does the TSO procure this service?

- These service is trade in the MSD

What are the obligations for the subject entitled to provide the service?

- Install at the physical control center of the unit the software tools provided or identified by the TSO for receiving dispatching orders
- A telephone communication system to be used also in case of unavailability of the computer system for receipt dispatching orders
- Make fully available, exclusively, to the TSO the use of residual margins with respect to the maximum and minimum (or eventually zero production)
- Notify the TSO temporary unavailability or variations relative to balancing service
- Submit bids on MSD

Tertiary reserve requirements

- The tertiary reserve requirement is defined
 - for each zone and
 - for each zone aggregation

Guide line the tertiary reserve requirement definition

- *The tertiary reserve requirement is defined take into account all possible events the require the use the tertiary reserve:*
 - A deterministic criteria is adopted to take into account the event associated the the non scheduled unavailability of the generating units and load units;
 - An probabilistic criteria to take into account the events associated to the error in the demand forecast and in the non-programmable energy source production
- Since the these events are independent, assumptions about their contemporaneity and geographical coincidence are made

Determination of up replacement reserve

- For each time period, the requirement of *up replacement reserve* for an aggregation of zones (or for a zone) is used to manage the worst following events:
 - failure of the biggest thermoelectric PU in service in the aggregation zones (zone);
 - error of the electricity demand forecast and production of non-programmable renewable energy sources forecast for the aggregate or zone, assuming that the two forecast errors are independent.
 - failure of the UP thermoelectric in testing

Determination of up ready reserve

- For each time period, the tertiary up ready reserve is sized to cope with the heaviest of the following events, which are assumed not simultaneous:
 - Complete restoration of the secondary reserve requirement of the aggregate.
 - Delay / advance of the electricity demand compared to the load forecast, in particular during the ramps / derampe load.
- Il fabbisogno di riserva pronta di zona è proporzionale al fabbisogno di riserva pronta dell'aggregato di zone in cui la zona è localizzata, in ragione del rapporto tra la domanda di energia elettrica della zona e dell'aggregato.
- *The up ready reserve* of an area aggregation is distributed among the areas proportionally the ration between the load of the area and the load of the aggregation

Determination of down ready reserve

- For each time period, the requirements of down ready reserve tertiary for an aggregate of zones or zone is dimensioned to cope with the most severe events among the following events, which are assumed not simultaneous.
 - Unscheduled unavailability of the biggest pump unit in service
 - Maximum error expected in the demand forecast and not programmable renewable sources forecast, assuming that the two forecast errors are independent

Balancing resources

- Goals
 - To keep the balance between injections and withdrawals of electricity
 - For solving network congestion
 - To restore the correct secondary reserve margins
- For Balancing Service the TSO:
 - activates resources of the tertiary reserve scheduled in the ex-ante MSD
 - accepts real-time bids submitted by enabled generating units
- The service consist to modify the power produced

Two different balancing services:

- **Up balancing:**
 - The power produced is increased (equivalent to a reduction of withdrawal)
- **Down balancing**
 - The power produced is reduced (equivalent to a increase of withdrawal)

Who is authorized to provide the service?

- Relevant PU that:
 - must be connected to the RTN
 - not belong to the following categories:
 - UP powered by non-programmable renewable energy sources
 - UP functionally related to production cycles, (CHP included) if the UdD unit states the impossibility to modulate the production
 - CIP6 / 92,
 - UP in the testing
 - are able to start to change the power within 5 minutes after request received from TSO, if the PU is already synchronized with the network
 - are able to change its power at least 3 MW within 15 minutes from the arrival of a dispatch order
 - limited to hydroelectric units, the ratio of the energy that can be produced in a day and the maximum power of the unit is at least 4 hours
 - the physical control center of the unit is manned and capable of performing dispatching orders 24 hours 24 and 7 days on 7
- Nota:
 - Note that the limit of 3 MW within 15 minutes is less restrictive than limit required to provide tertiary reserve. In this way, in real time, it is possible to use more resources to restore the security conditions in situation with limited resources

How does the TSO procure this service?

- The balancing service is traded in the MSD

What are the obligations for the subject entitled to provide the service?

- Install at the physical control center of the unit
 - software tools provided or identified by the TSO for receiving dispatching orders
 - a telephone communication system to be used also in case of unavailability of the computer system for receipt dispatching orders
- Make fully available, exclusively, to the TSO the use of residual margins
- Submit a bid in the MSD
- Tender on MSD
- Implement their own binding programs, as specified in paragraph
- Notify the TSO temporary changes in their technical data or unavailability to participate to balancing service
- Implement the dispatching orders