FLEXIBILITY IN FUTURE POWER SYSTEMS

AN EVOLVING POWER SYSTEM

Trends influencing operation and planning
- Increasing the maximum utilisation level
- More distributed generation, new ancillary service solutions
- More and larger interconnections
- Power electronic interfaced devices (PEID) instead of rotating machines

Challenges to maintain secure and stable operation
- Identification of true operational state and limits
- Increasing need of information exchange
- New system and operational criteria
- Changed dynamic response

WHAT IS FLEXIBILITY?
Flexibility may be provided and handled by several parties, however flexibility is lacking a common definition! CEER propose:

Flexibility is the capacity of the electricity system to respond to changes that may affect the balance of supply and demand at all times

RATIONAL FOR FLEXIBILITY

Secure future power supply - maintaining the frequency
- Conventional solutions:
  - Balancing provided by generation, restricted by flexibility of generation units within the system
  - Additional balancing through DC connections to other systems
  - Flexibility in demand using bi-lateral agreements
- More weather dependent supply requires additional solutions:
  - Increased flexibility from thermal power plants: broadening operating ranges (minimum load levels and ramping rates) and shortening start-up time
  - Intermittent power generation flexibility: to provide balancing
  - Aggregated control: multiple smaller units, including storage
  - Evaluate possibilities of increasing the operational flexibility
  - Minimum/maximum frequency deviation, RoCoF requirements, etc.
  - May impose altered requirements of units and systems in the grid

Secure power transfer capacity
- Conventional solutions:
  - Increasing nominal voltage levels
  - Installation of devices: series-compensation, phase-shifting transformers, FACTS, etc.
  - System integrity protection schemes (SIPS or SPS)
- Increased system utilization requires additional solutions:
  - Dynamic line rating (DLR) for over-head lines
  - Dynamic rating for other assets, such as cables, may be future solutions to increase the flexibility
  - Time variable transfer tariffs, to influence behavior of demand and supply to prevent congestion
  - Evaluate possibilities of increasing the operational flexibility
  - Probabilistic reliability criteria - instead of the deterministic n-1 criterion - to further increase flexible utilization of assets

Secure future energy supply
- Conventional solutions:
  - Seasonal: stockpiling fuels and use of hydro reservoirs
  - Daily: pumped hydro
- More weather dependent supply requires additional solutions:
  - Larger need for energy storages to provide flexibility in storing energy from situations of high supply to situations with low supply
  - Altering demand behavior: flexible loads following supply variations

Maintaining voltage stability and power quality
- Conventional solutions:
  - Reactive power capabilities of generation, compensation units and FACTS devices
  - Increased PEID provides new solutions:
  - Ancillary services from distributed generation, storage and demand
  - Evaluate possibilities of increasing the operational flexibility
  - Acceptable ranges for power quality
  - May impose altered requirements of units and systems in the grid