

Demand as Frequency Controlled Reserve

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On the one hand...

- Demand and production have to be in balance
 - Time horizon: Seconds - Minutes
- Balance have to be quickly reestablished after loss of a power plant or transmissions corridor
 - Today covered by fast frequency activated reserves
 - Mainly from power plants or import

On the other hand...

- A large share of the load can be disconnected in a short period without problems
 - Heating
 - Freezers
 - Refrigerators
 - Circulation pumps
 - Coffee machines
 - Tumble driers
 - Washing machines
 - Dish washers
 - Industrial loads, e.g. with thermal storage
 - Water tower, dewatering
 - Light in greenhouses
 - UPS units

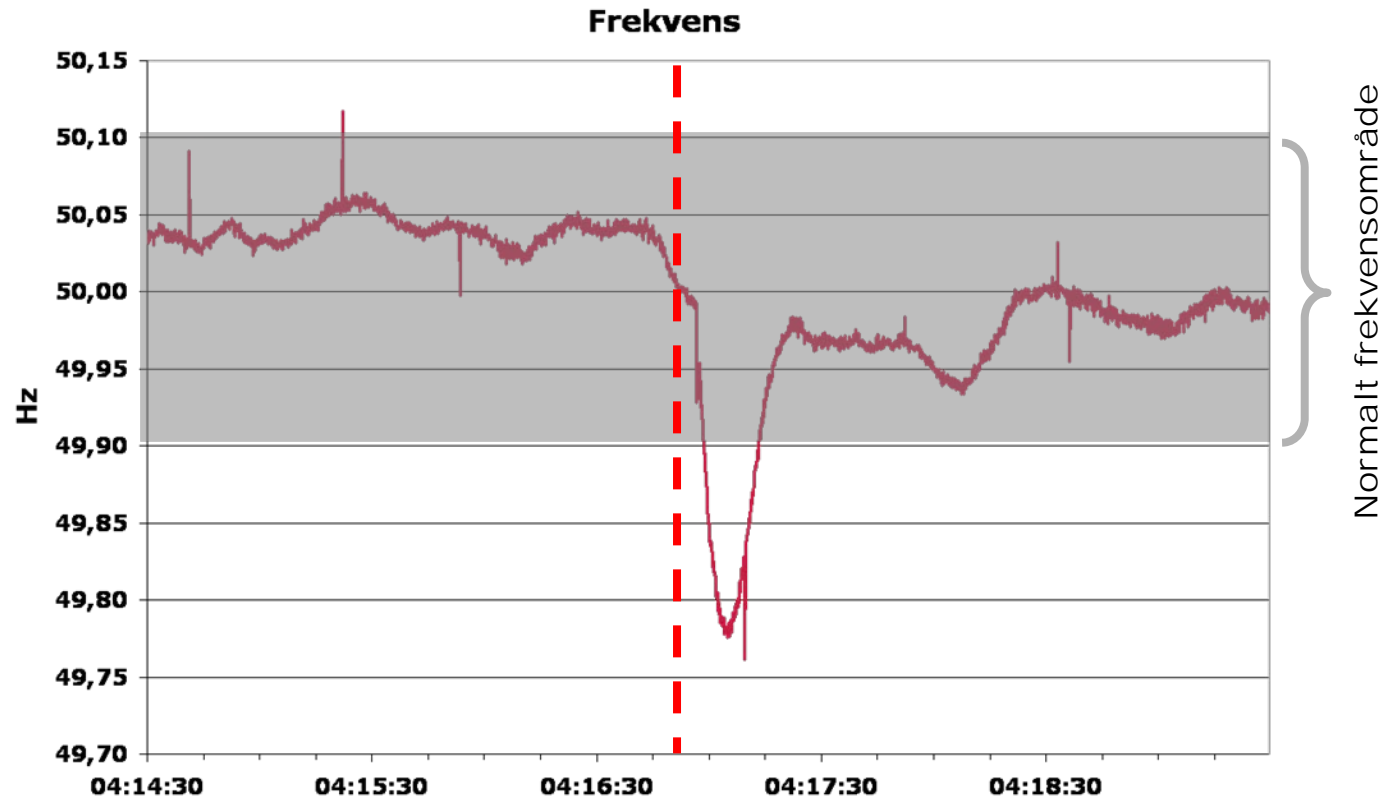
Demand controlled by the frequency can provide a more efficient and less expensive power system

- Potentially momentary response - essential in frequency stability maintenance
- Flexible and distributed - good for stability enhancement
- Potentially low investment and maximal use of available resources

But open questions exists...

- How should it be designed?
 - Set-points
 - Disconnection and reconnection
 - Different systems (DK east / DK west)
- Qualitative benefits for the system?
- Communication or no communication?
- Monitoring of the reserve?
- Business model (marked)?
- ...

Oktober 30th 2005, 04:16: Loss of Kontek

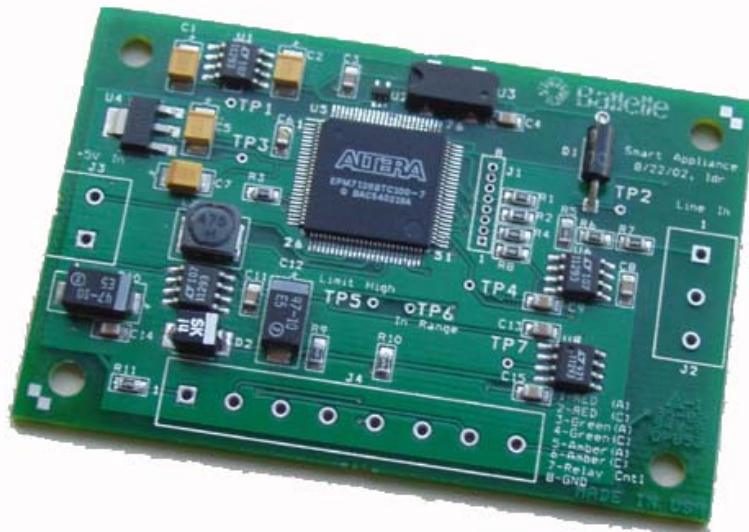


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New electronic provides new possibilities

- The frequency is the same in the whole interconnected power system, e.g. in Nordel or UCTE
- A chip of the size of a credit card can measure frequency and disconnect load in milliseconds – far faster than production can be increased



PSO project “Demand as Frequency Controlled Reserve”

- 2 year project started April 2006
- Financed by PSO (Public Service Obligations) managed by Energinet.dk
- Project partners
 - Centre for Electric Technology, Technical University of Denmark
 - Ea Energianalyse
- Objective: analysis, assessment and system design
- If success, followed by a demonstration phase

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Project participants

- Project group
 - Prof., head for centre, Jacob Østergaard, CET
 - Ass. prof. Zhao Xu, CET
 - Partner, Michael Togeby, Ea
 - Partner, Kaare Sandholt, Ea
- Support from Pacific Northwest National Lab. (PNL), US
- Advisory group
 - Energinet.dk, NESAs, DONG Energy, Statnet (NO), Svenska Kraftnet (SE)
- Following group
 - Coordination with other PSO-projects

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Work Packets

1. Eksplorative analysis of system design for demand as frequency reserve
2. Dynamic simulations of concepts
3. Monitoring of the variable reserve
4. Strategy and practical implementation
5. Conclusion and evaluation

Thank you for the attention!

- For further information please visit:
 - www.oersted.dtu.dk/cet
 - www.eaea.dk
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