IEEE Electrical Power and Energy Conference 2009

On-Line Management, Control and Optimization of Electricity Generation

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OPTIMISATION ?

Supply Mix

Lowers price of kWh or Maximal profit

Free spinning no load reserve

No blackouts

When all units generate at the best efficiency costs are ~minimum – ~lowest price $/kWh

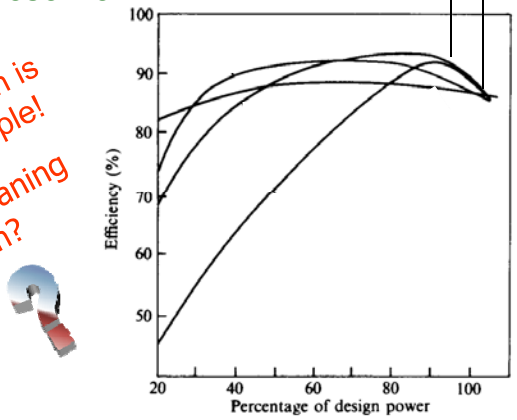
Difference between power at high efficiency and design (rated) power is the cheapest (free) spinning reserve.

CHEAPEST

Spinning reserve

Optimisation is not so simple!

What is the meaning of optimisation?

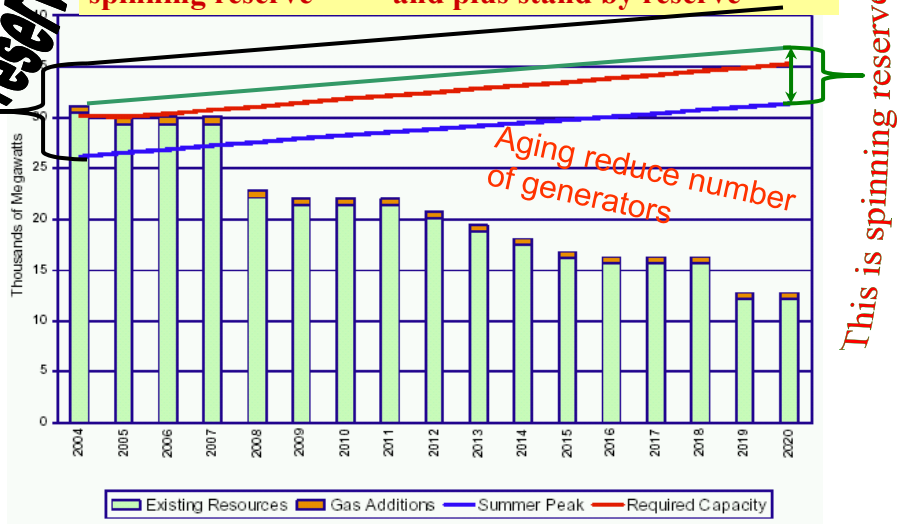


Existing resources include Required Capacity

which must be above consumption plus

spinning reserve and plus stand by reserve

reserve



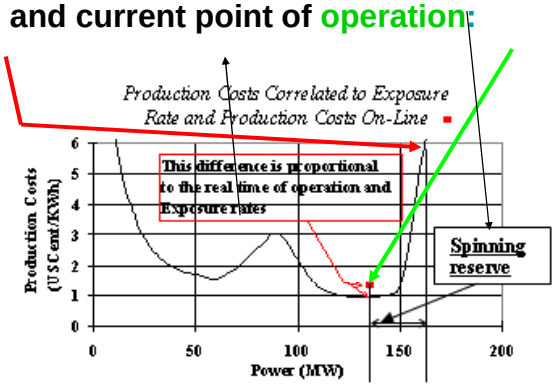
Aging reduce number of generators

This is spinning reserve

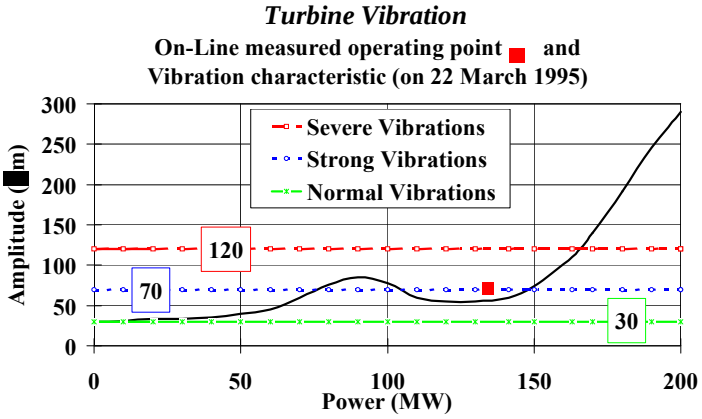
Basic data from Shane Pospisil, Sep. 28, 2004

Characteristic Production Costs

When units operate with lowest costs, contributed spinning reserve is the difference between possible overload and current point of operation:

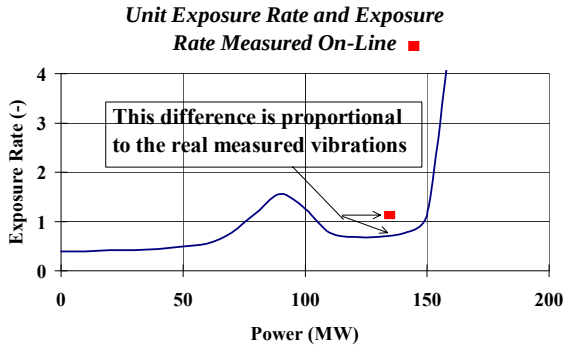


Spinning reserves of all running generators form total system reserve

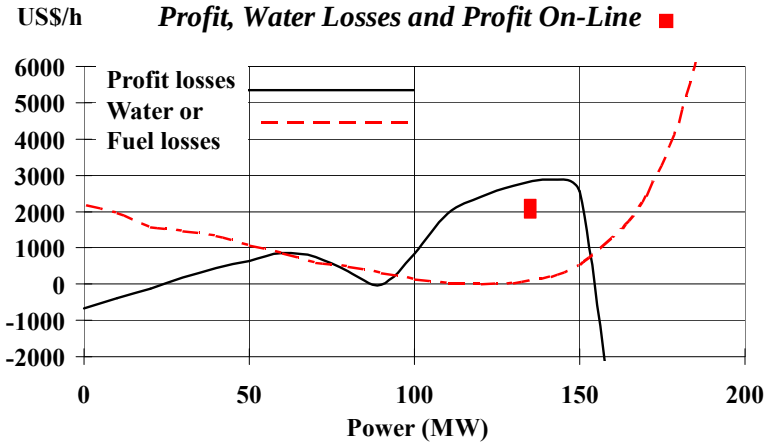


When bearing vibrations are close to prescribed limits (120 mμ), **operation is acceptable,** but only under close monitoring and supervision; if this limit is exceeded, **accidents should be expected**

$$Exposurerate = \frac{time\ of\ aging}{real\ time}$$



$$E_R = E_R(T, A, F, Q, H, n, n_s, \sigma, Type, Quality, Stress, Fatigue, erosion, Corosion, Condensation, Air\ content, Fluid\ characteristics, ...)$$

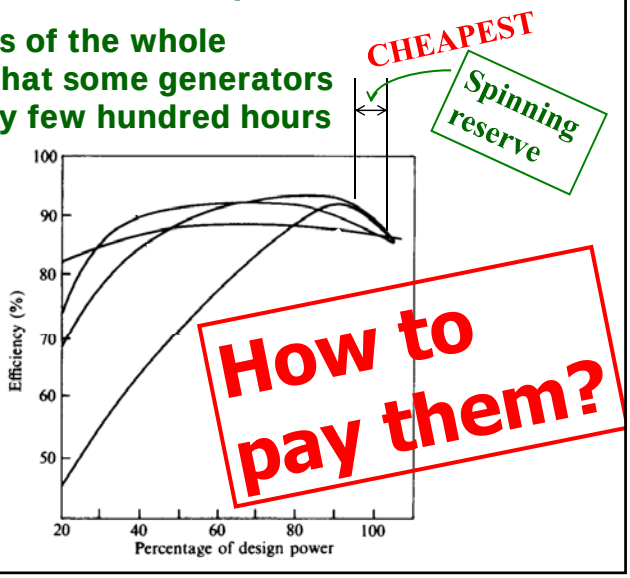


When all units generate at the best efficiency (or the lowest costs) total costs are not minimum.!

Each generator has its lowest price.

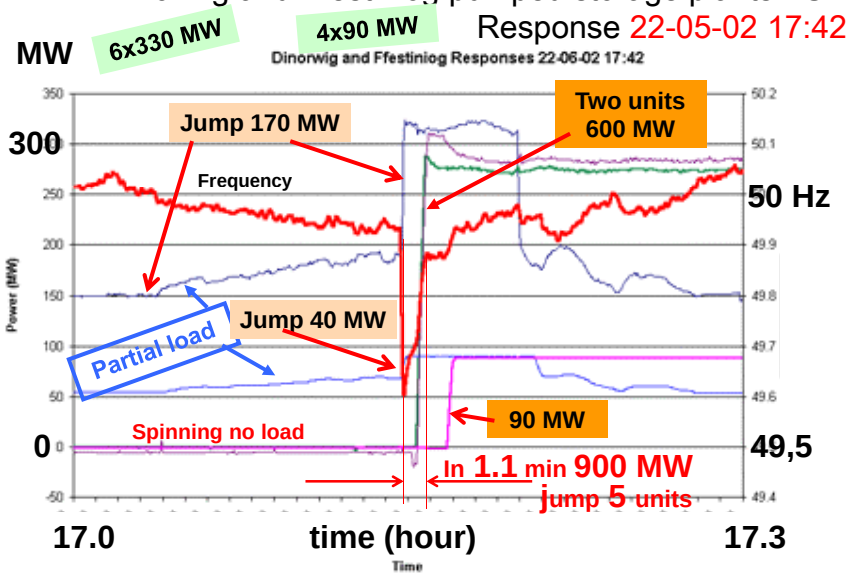
The lowest costs of the whole system means that some generators will operate only few hundred hours per year and

some will not operate at all, but system must have them as a reserve



Dinorwig and Ffestiniog pumped storage plants - UK

Response 22-05-02 17:42



210 MW jump in few seconds; 920 MW in few minutes

Requirements for New Graduates
end
Experts

- **New graduates, particularly Masters or PhD**
- **Should have 10 to 15 years of design experience**
- **Should have 10 to 15 years site experience**
- **Able to select and read journals and textbooks.**
- **When few experts, learning time should be increased**
  - **Number of accidents and errors must be reduced**
  - **Education costs *millions*, accidents cost *billions …* and can *endanger lives***

- Planned multidisciplinary transfer of know-how
- Assignment facing the electricity sector and universities in Ontario and Canada
- Pivotal decisions should have already been made.

Ontario and Canadian (US) universities are not teaching students

- **to design**
- **to maintain**
- **to operate**

electric plants and auxiliary systems of big power plants

Up-to-date Spinning Reserve

- Storage and pumped storage hydro plants are today economical and reliable solutions; lowest costs.

- Generators running hydrogen production will eventually be solution for clean fuel storage and spinning reserve.

(But when?)

Need for Reserve

- As Banks must carry a credit reserves to avoid financial instability and runs…
- So power production must carry an operational reserve.
  - This cannot be paid for in the same way as power consumed!
  - If not put in place, the system will fail again and again….

Immediate Priorities

- **Peak generators**
- **Speed no load generators**
- **Stand by generators**
- **Renewable energy production**
- **Transmission lines**
- **Energy conservation**
- **Production optimization**

We must pay for car insurance

but

Neither car owners nor insurance companies want accidents or claims

Ontario must be insured with running and spinning no-load reserve

or

we will all have to pay billions for blackouts

Without explicit consideration of production and spinning reserves

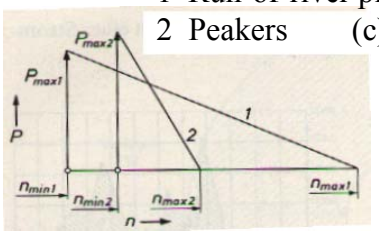
stability in the generation system cannot be achieved.

Instability create huge economic and social consequences.

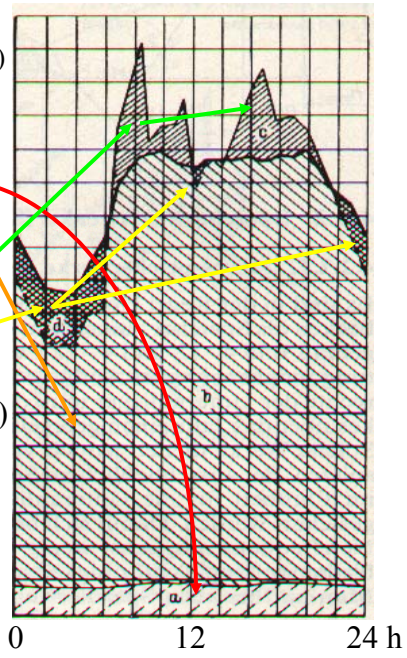
BLACKOUT becomes inevitable

Generation Consumption

a Hydro run-of-river generators
b Thermal and nuclear plants
c Peakers: Storage plants & pumped-storage plants
d Pumping / storage



1 Run-of-river plants (a&b)
2 Peakers (c)



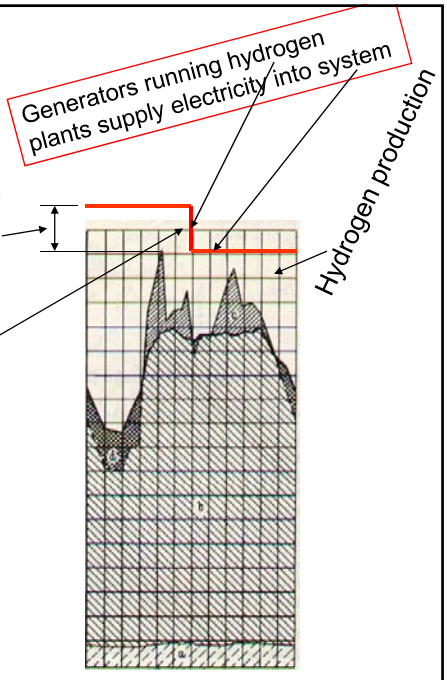
Spinning reserve

Hydrogen production must be equal to the spinning reserve

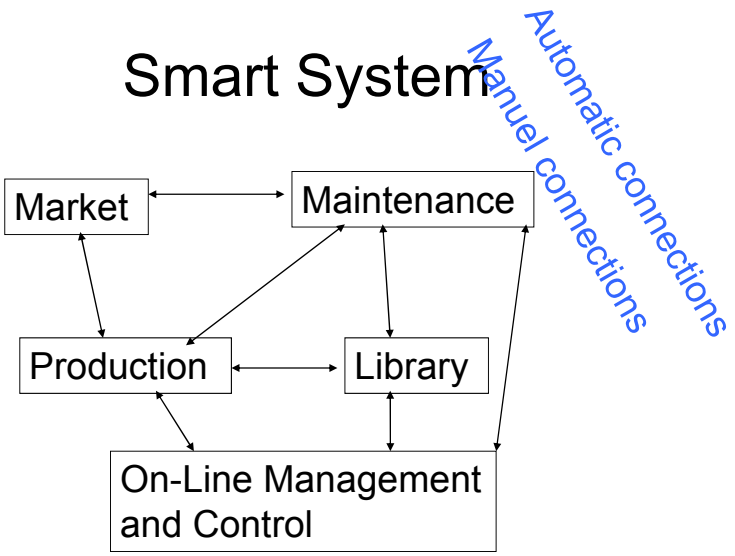
When the biggest generator system fail production of hydrogen is automatically reduced

blackout prevented.

Future 10 – 20 years?



Smart System



Mississauga PEO Chapter Presents

Hydro Power and Storage Technology

- **Presented by:** **Dr. Stan Pejovic**
- **Date**: **Wednesday, October 28, 2009**
- **Location**: **Mississauga Central Library, Class Room #3**
  301 Burnhamthorpe Rd. W.,
  Mississauga, ON., L5B 3Y3

  Time: **7 PM – 9 PM**

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The End

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