

IEEE Electrical Power and Energy Conference 2009

On-Line Management, Control and Optimization of Electricity Generation

S. Pejovic

e-mail: pejovics@asme.org

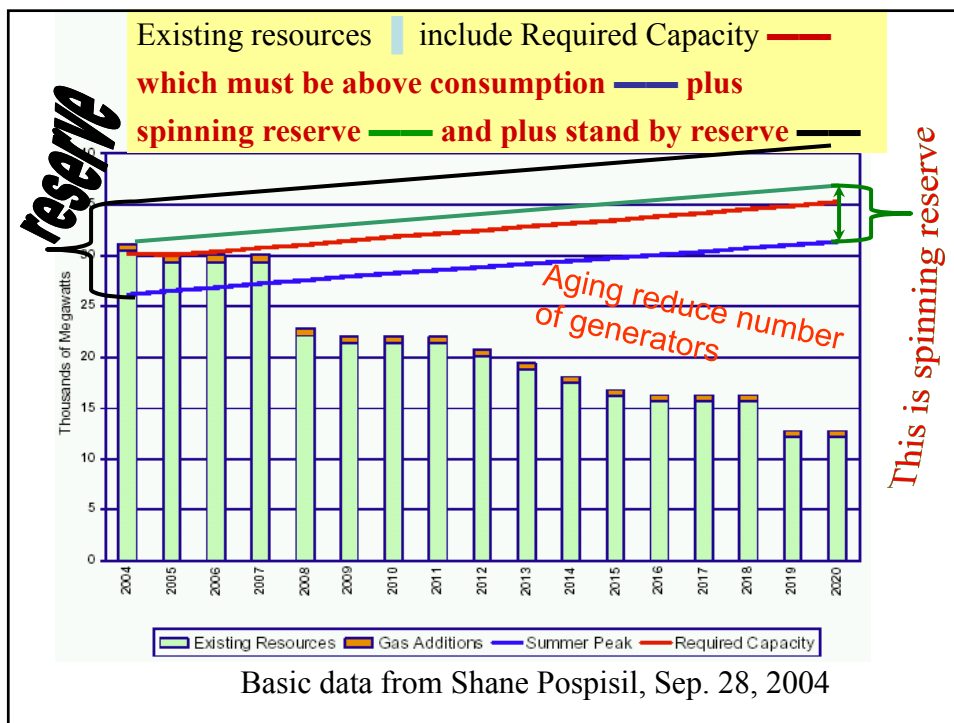
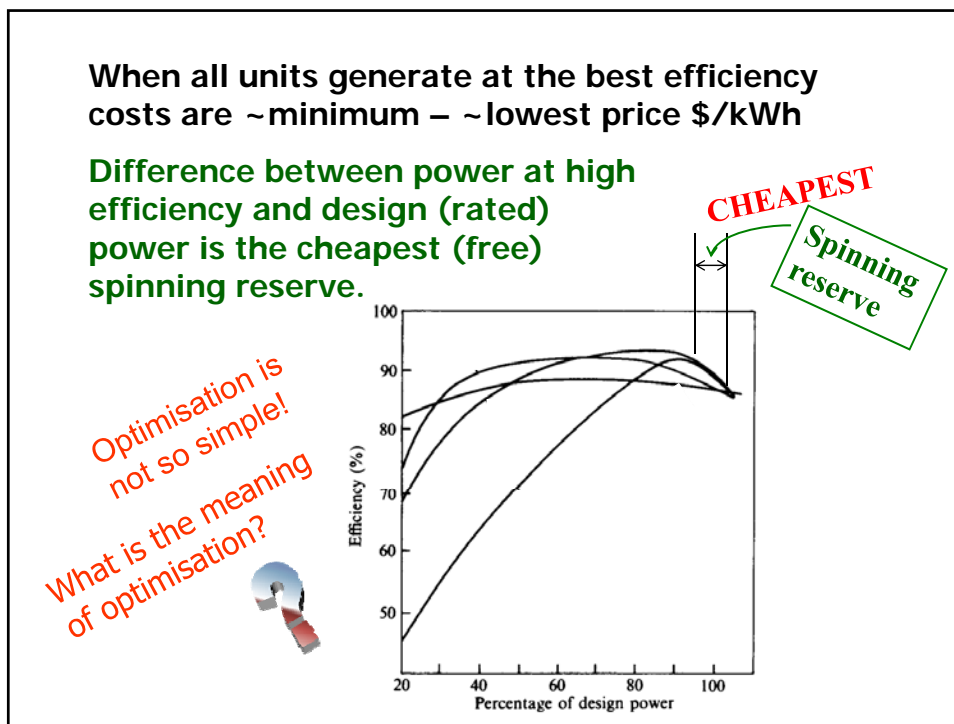
OPTIMISATION ?

Supply Mix

Lowers price of kWh or Maximal profit

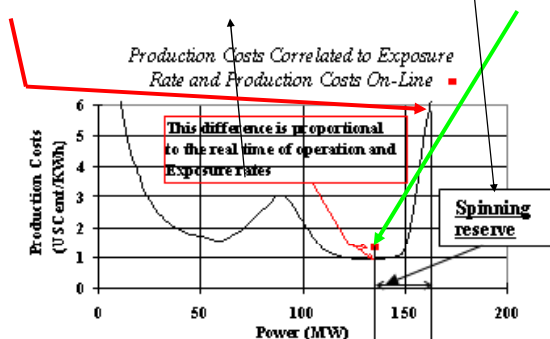
Free spinning no load reserve

No blackouts



Characteristic Production Costs

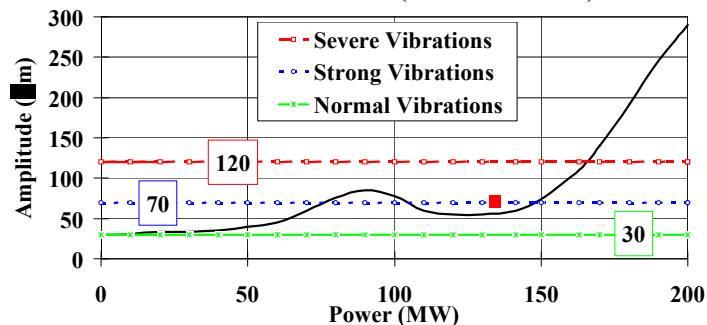
When units operate with lowest costs, contributed spinning reserve is the difference between **possible overload** and current point of **operation**:



Spinning reserves of all running generators form total system reserve

Turbine Vibration

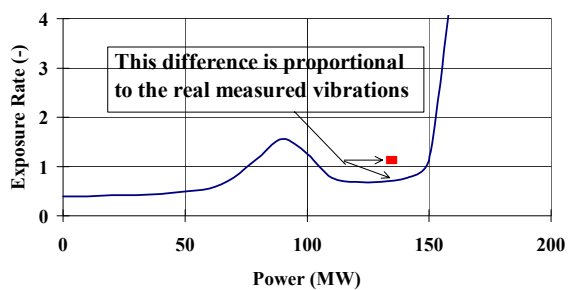
On-Line measured operating point ■ and Vibration characteristic (on 22 March 1995)



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

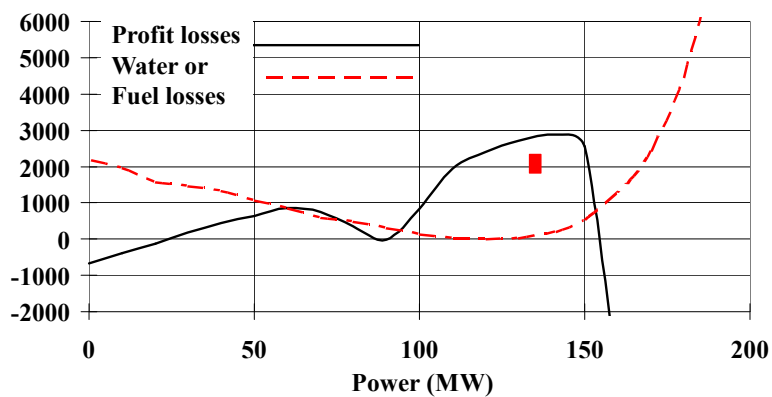
$$Exposure\ rate = \frac{time\ of\ aging}{real\ time}$$

Unit Exposure Rate and Exposure Rate Measured On-Line ■



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

Profit, Water Losses and Profit On-Line ■

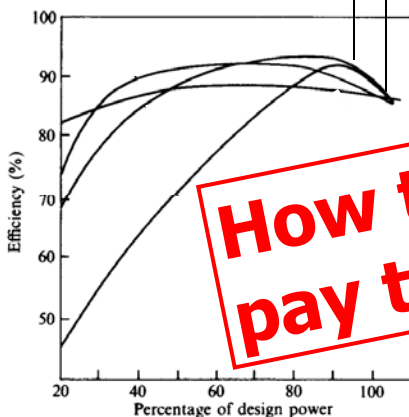


When all units generate at the best efficiency (or the lowest costs) total costs are not minimum.!

Each generator has its lowest price.

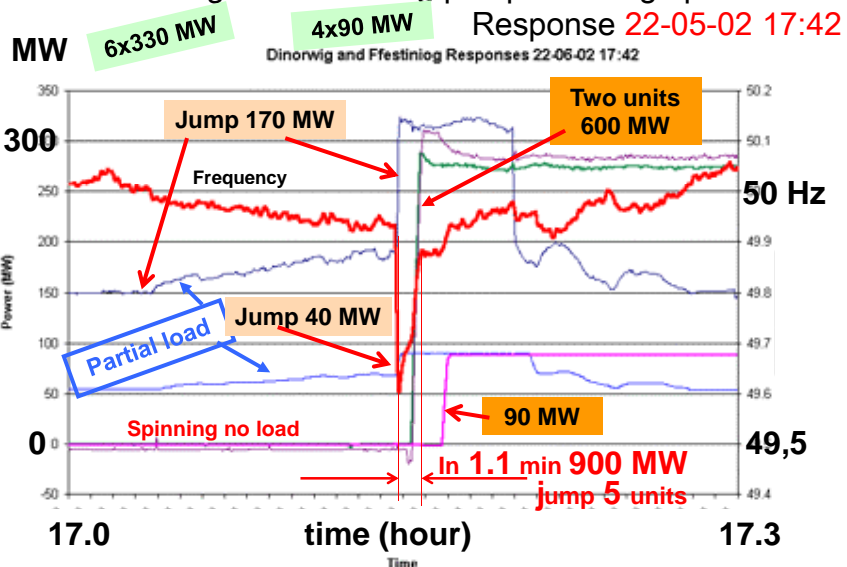
The lowest costs of the whole system means that some generators will operate only few hundred hours per year and

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



How to pay them?

Dinorwig and Ffestiniog pumped storage plants - UK



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

Requirements for New Graduates

and

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

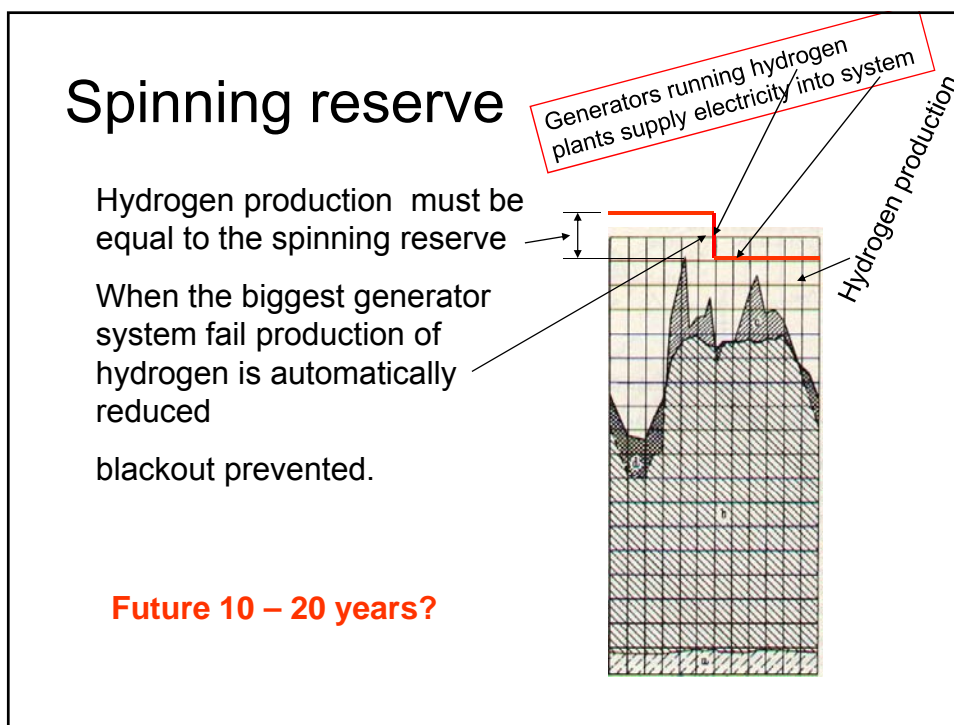
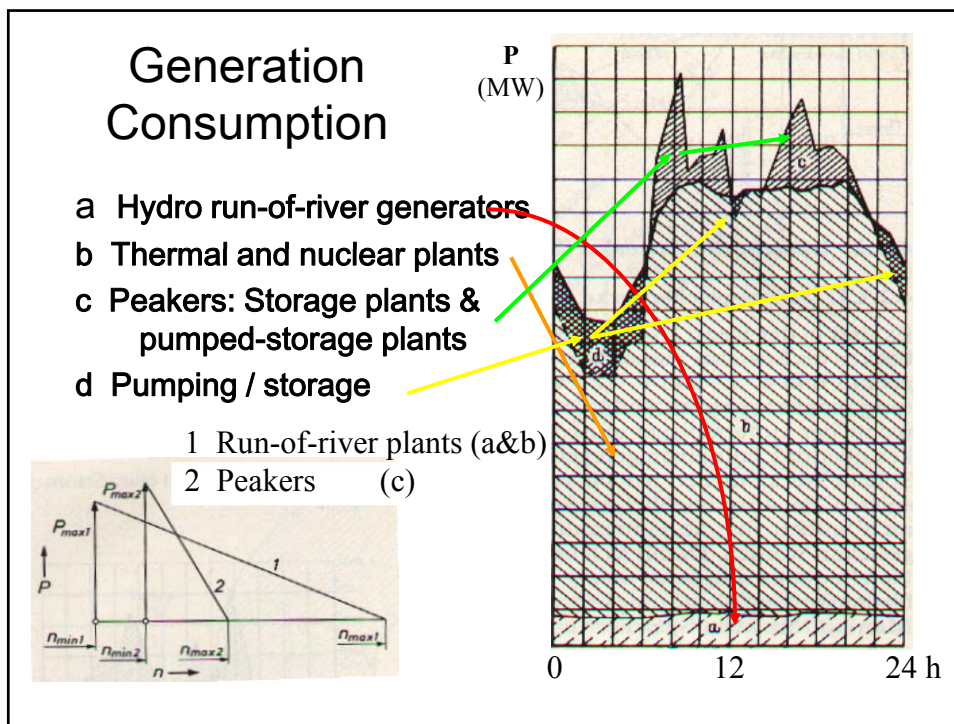
We must pay for car insurance
but
Neither car owners nor insurance
companies want **accidents** or claims

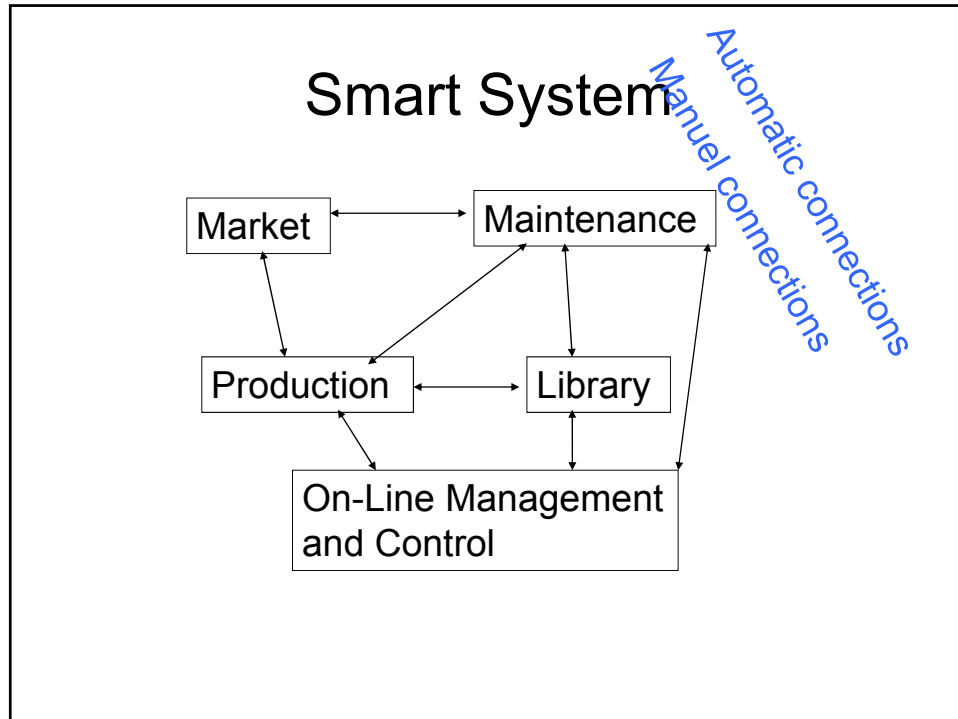
Ontario **must be insured with** running and
spinning no-load reserve
or
we will all have to **pay billions for
blackouts**

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





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

The End

Thank you for your attention!

Prof. Stanislav Pejovic, Ph.D., P.Eng.

1411 - 300 Webb Drive, Mississauga, ON, L5B 3W3,

Tel: (905) 896-1253, Cell: 416-270-8126

E-mail: pejovics@asme.org,

Website: <http://individual.utoronto.ca/StamPejovic/>