

A Speculative Peak into the Future

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Renewable Energy and Smart Technology

Renewable Energy Challenge may be Small or it may be Big

- The Small Potato Certainty
- The Big Potato Potential

The Small Potato Certainty

- **“Small” refers to Solar/Wind/Renewable generation content**
 - 5%, 10% maybe up to 20% of the system
 - This is what is envisaged in the near term future; lots of work going on
- **This is what people mean by smart grid applications**
 - Voltage control using smart technology (Intelligent SVCs)
 - Switching technologies to improve grid performance
 - HVDC
 - Optimising transmission system usage
 - Distribution automation

The Small Potato System

- **System still dominated by large rotating masses**
 - Conventional stability and frequency dominate operating concerns
 - Conventional optimality and energy planning dominate dispatch
- **System tied by a great transmission grid, but small potato can help**
 - Synchronous operating limits problem modified by fast, smart activation of new power sources
 - Voltage control and reactive dispatch issues modified substantially
 - Smart solar plant reliability services
 - Smart frequency control
 - Smart voltage control
 - But needs 10 to 20% headroom for fast response

The Big Potato Challenge

- **Generation economics is changing**
 - Imagine future levelised cost of energy (In today's money in US\$)
 - Nuclear \$120 / MWh
 - Coal \$ 100 / MWh
 - CCGT \$ 50 / MWh
 - On-shore Wind \$ 50 / MWh (Available quantity uncertain)
 - Solar \$50 / MWh (Available quantity uncertain)
- **Solar and wind WILL (why not?) produce 30, 40, 50%**
- **Dominance of rotating masses in system dynamics declines**

Technology of the Big Potato

- **Since non-rotating-mass generation is more than 30%**
 - New and smart approach to system reliability
 - New and smart approach to frequency definition
 - Power swings and stability issues take on a different meaning
 - New and smart approach to voltage control
 - Frequency – transmission – transformer have to be reconsidered
 - Within minutes restart capability after system shut down
 - Battery pricing, battery technology or other storage
- **A whole new ball-game; rewrite all the textbooks**

END