Introduction to Instantaneous Reserve

A presentation to the Wholesale Advisory Group

28 November 2013

What is instantaneous reserve (IR) for?

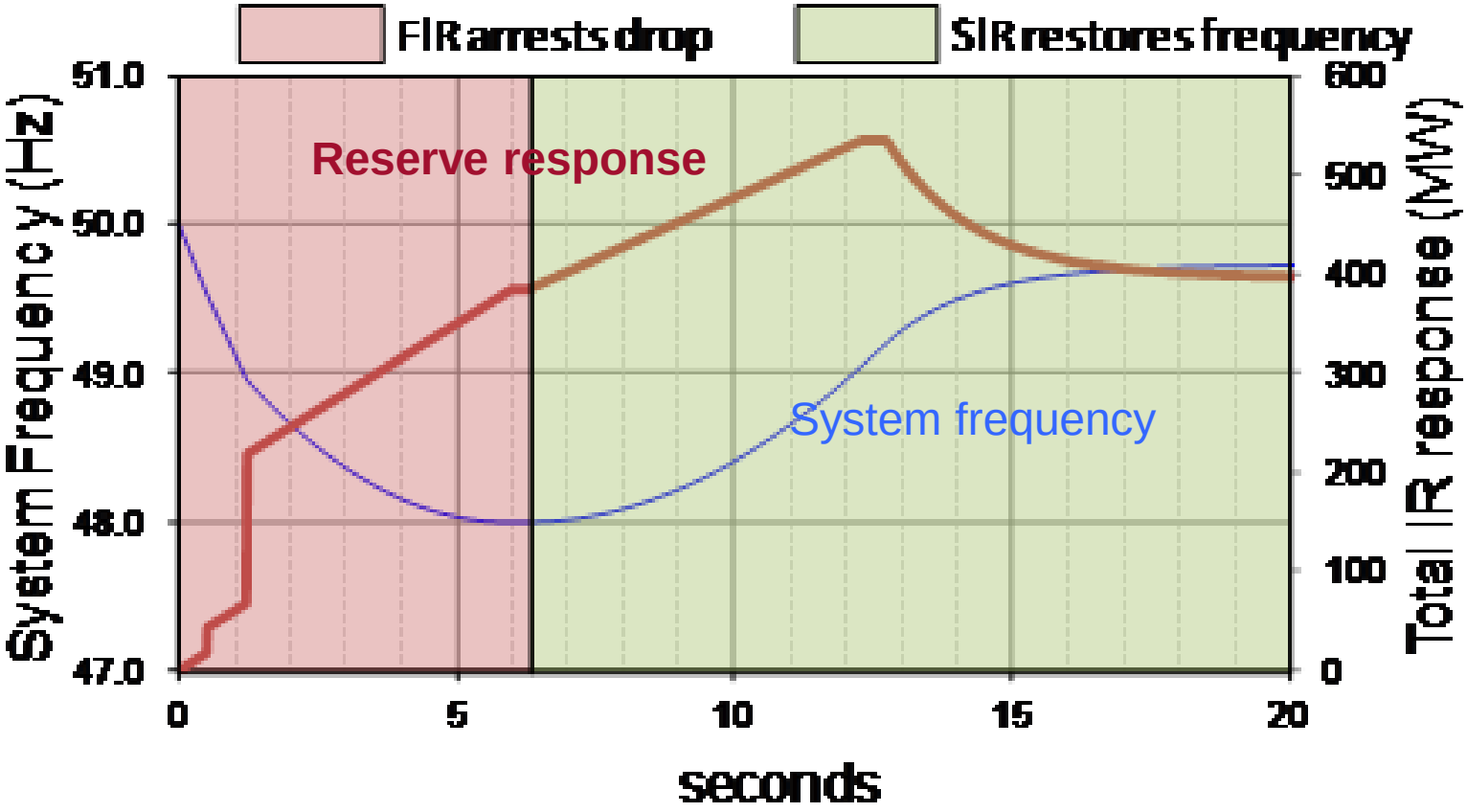
IR enables the electricity system to respond to the loss of the largest single supply asset (the risk setter) without interrupting supply to load (frequency to stay above 48Hz - CE)

IR can take two forms:

- 'spinning reserve‘ ➔ a generator increases generation
- 'interruptible load' (IL) ➔ a load reduces demand

Currently, there are two distinct IR products:

- Fast IR (FIR) *arrests* frequency fall
  - needs to happen in a few seconds
- Sustained IR (SIR) *restores* frequency to the normal band
  - must happen within 1 minute, and be sustained for 15 minutes



Step changes in response = IL ‘dropping off’

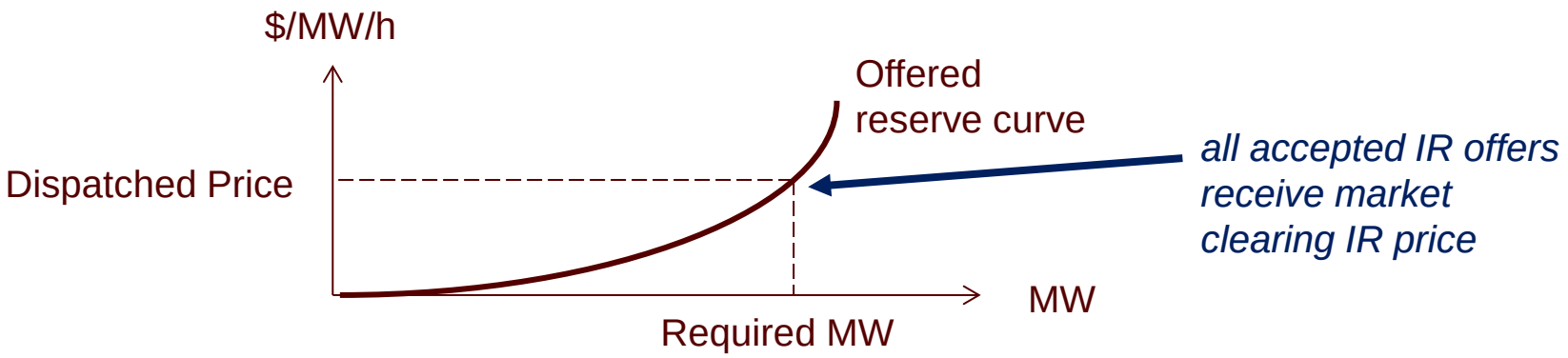
Gradual change in response = spinning reserve changing output

What if there were no reserves?

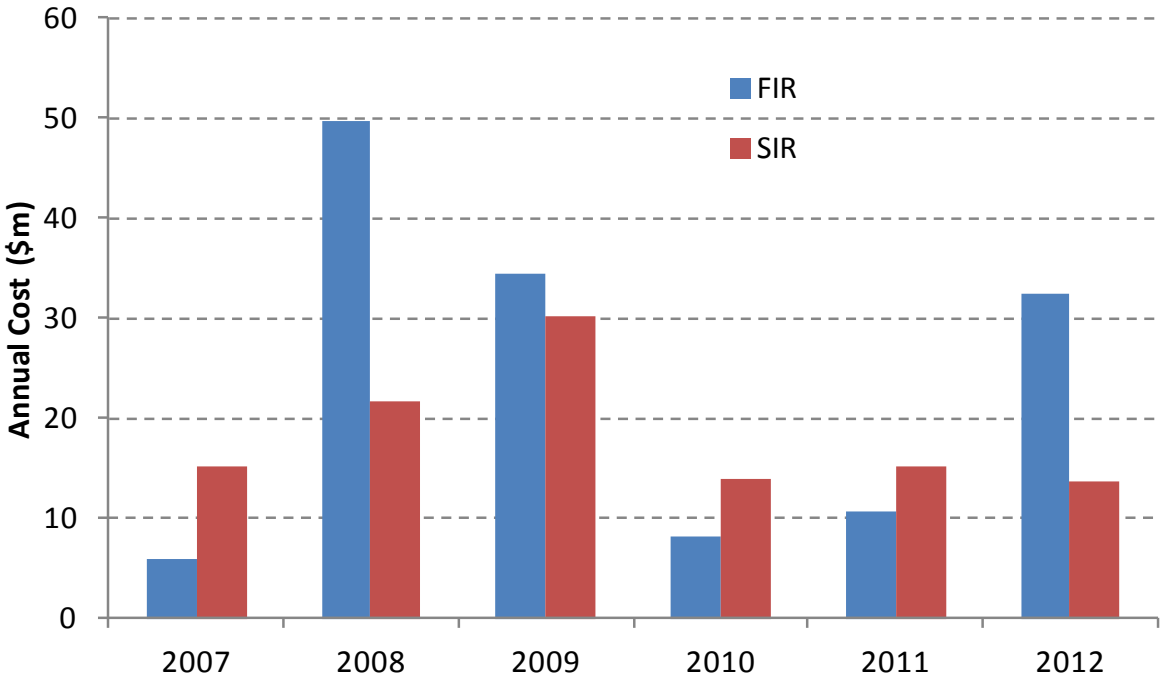
How the price of IR is currently determined

IR is procured in order of cheapest to most expensive (the offered reserve curve), until enough IR is purchased:

- amount of SIR required is always equal to the size of the largest risk
- amount of FIR required is calculated by a tool called ‘RMT’
  - dynamic modelling based on specifics of the largest potential event
- spinning reserve and IL are treated identically in the dispatch process
- this is the same procurement system as used in the energy market
- IR is procured separately in the North and South Islands



Annual IR costs



Variation depends on factors such as:

- energy prices (dispatch process co-optimises energy and reserves)
- level of HVDC transfers (level of transfer often sets risk to be covered)

IR costs are recovered from causers

Principle is to allocate costs to persons who “cause” the need for IR to be available in case their assets fail:

- HVDC owner (Transpower)
- generators with units over 60MW

Intent is that over time, price signal will incentivise these parties to reduce the need for IR procurement, and therefore reduce IR costs

- e.g. through their investment, maintenance, and operating decisions

Cost allocation methodology is set out in the Code

IR costs are recovered in two parts

- availability charges
  - IR costs *in each half hour* allocated to generators and the HVDC in proportion to quantity each injected that half hour, over 60MW
  - 60MW de minimis recognises that loss of smaller units is unlikely to result in cascade failure, and therefore they do not contribute to need for IR

- event charges
  - generation or transmission units that trip and cause frequency to fall below 49.25 Hz are allocated under-frequency event charges
  - charge is MW (less 60 MW) that tripped, multiplied by $1,250/MW (an approximation of costs of an under-frequency event)
  - event charges are rebated to parties that pay availability charges

Recent developments

Many sources of new generation (particularly wind) are low-inertia

- with lower system inertia the frequency falls faster so the existing reserve arrangements are being reviewed

The new HVDC pole and control system have significant potential beneficial impact on the IR market

- directly reducing the requirement for reserves
  - risk posed by HVDC is much lower when operating in 'bipole' mode; if one half of HVDC trips, other half can increase flow to compensate
- potential for National Reserves Market (NRM)
  - reserves can be *shared* between two islands in a single market; this could result in a lower amount of reserves being procured overall

Problems identified with current approach

Systematic over-procurement of IR:

- inefficient delivery of agreed security policy (set out in Policy Statement)
- over-frequency risk following an event (especially AUFLS event)

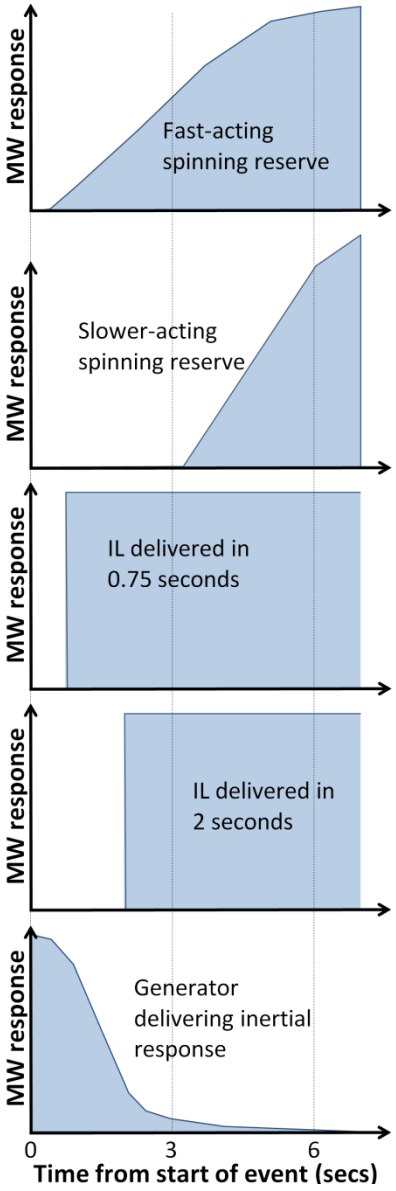
Technical causes:

- not co-optimising SIR and FIR procurements (particularly not recognising SIR which can contribute to FIR)
- under-estimating net free reserves
- RMT unable to calculate amount of SIR required

Market design causes / issues:

- FIR is paid based on reserve output at 6 second, whereas:
  - need can be < 6 seconds
  - some providers who deliver early (e.g. inertia) aren't paid at all
  - IL provided in <1sec is not rewarded any better than a slower acting response
- SIR is paid based on average output over 60 sec, whereas:
  - need is output at 60 secs

Problems with FIR procurement



Value of FIR is its cumulative contribution over the time frequency is arrested

- e.g. 10 MW delivered in 0.5 sec can be more valuable at arresting frequency than 20 MW delivered in 5 sec

But FIR is currently paid based on reserve output at 6 sec

- over-pays for slow-acting reserve – particularly for covering severe potential events which may require response much earlier
- does not reward inertia at all

Any questions?