Under-frequency management (UFM) project

Presented to the Security and Reliability Council

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Background

Under-Frequency Management (UFM) consists of the range of measures used to prevent frequency collapse following the loss of a major supply asset.

UFM measures principally comprise:

- Instantaneous reserves (IR)
- Automatic under-frequency load shedding (AUFLS)
- Asset owner performance obligations (AOPOs)

The UFM Project

A comprehensive review of the suitability of all UFM arrangements

Progressed jointly by the system operator (SO) and Electricity Authority (Authority) since 2011

Two areas identified as requiring major overhauls

- AUFLS
  - SO is progressing a revised quantity standard and technical design (i.e. increased number of blocks, with rate-of-change-of-frequency triggers)
  - Authority is progressing revised procurement approaches
- IR ← The focus of this presentation

Current IR Arrangements

SO procures IR in the form of spinning reserve and interruptible load (IL) to cover the loss of the largest single supply asset in each half hour (the 'contingent event'). Two types of IR:

- Fast IR (FIR). *Arrests* frequency fall. Required to respond within 6s (1s for IL), and maintain for 60s
- Sustained IR (SIR). *Restores* frequency to the normal band. Must respond within 60s, and maintain for 15 min

Quantity of FIR required is dynamically calculated by reserve management tool (RMT). SIR quantity is simply set equal to size of contingent event.

Issues identified

Systematic over-procurement of IR

- Excessive costs (≈$50M net present value)
- Potential for over-frequency collapse if IR over-delivers

RMT is aging

- Significant accumulation of patches & fixes
- Sometimes fails to solve
- Difficult to incorporate potential IR improvements

Asset changes → new challenges & opportunities

- Weakening of system inertia, from new generation mix
- HVDC upgrade can enable a national market

Possible improvements

(see Appendix slides for more detail)

IR procurement

- National reserves market
- Altered IR procurement
  - 'Area-under-the-curve'
  - Co-optimisation of FIR & SIR
  - Faster or ‘dynamic’ FIR product definitions
- Inertia market
- Enabling wind to offer IR

Other arrangements

- Compliance
  - Penalising for over-delivery
  - Higher resolution IR metering
- Cost-allocation
  - Inertia
  - IR cost allocation
- AOPOs
  - Inertia

Linkages (including with AUFLS re-design), uncertainties, and constrained timetable (due to RMT replacement) require careful prioritisation and co-ordination

UFM Project Workstreams

	Approx. 20 yr NPV benefit	Status / timetable
Altered RMT modelling + Higher res'n metering	$23m	Low system implications. Detailed proposals in consultation. Possible 2013/14 implementation
National reserves market	$21m	Significant system implications. Currently developing options. Possible 2015 + implementation
Altered IR procurement **Area-under-the-curve** **FIR / SIR co-optimisation** **Faster reserve**	$44m	
RMT replacement	$7m*	
Inertia	$?	Undertaking studies to determine whether likely to justify development of arrangements
Over-frequency mgmt		
Wind offering IR		

Current project focus, as need to identify early on any issues with potential RMT replacement implications

* These do not include the benefits of enabling some of the above initiatives

Project Approach

The SO and Authority are collaborating on the UFM project:

- SO leading technical aspects
- Authority leading market design aspects

When combined with consultation, this provides a complementary mix of skills and perspectives

SRC discussion points

Can the SRC suggest any other issues or possible improvements to the UFM arrangements?

Does the SRC agree with

- the categorisation of issues into the workstreams?
- the relative priorities assigned to workstreams?

Does the SRC support the direction of the UFM project?

Links to further information if required

http://www.systemoperator.co.nz/ufm

http://www.ea.govt.nz/our-work/consultations/pso-cq/under-frequency-management/

Appendix slides

More detail on potential IR-related initiatives

Altered IR procurement (1)

Area-under-the-curve

Instead of paying providers based on the quantity of reserves they provide at end of set period (e.g. 6s after event for FIR, or 60s for SIR), pay providers based on how much they provide during this period

- Rewards providers who respond more quickly during this period
- Enables less reserves to be procured overall
- Facilitates paying for inertia, and more dynamic procurement

Altered IR procurement (2)

FIR / SIR co-optimisation

Currently have over-procurement because:

- Quantity of SIR required is simply set equal to size of contingent of event
- There is no recognition that most IR provides both FIR and SIR

Opportunities for improvements:

- Dynamically calculating quantity of SIR required; and
- Co-optimising between FIR & SIR

Altered IR procurement (3)

Altered FIR speed requirements

At moment FIR is defined as a 6s product (1s for IL)

However, actual speed of response required varies significantly with size of event

- For major event, 6 seconds is too slow → paying for some FIR which does not contribute to arresting freq. fall
- For minor event, can have much slower reserve providers → currently excluding slower providers who could contribute

Exploring options for improvement such as

- An additional ‘very fast’ product; or
- Using area-under-the-curve approach to dynamically determine how much reserve of what speed is required

National reserves market

Use HVDC to allow reserves in one island to be used to cover risk in other island → reduced quantity of reserves procured overall

Part of opportunity facilitated by improved technical capabilities of new HVDC

Inertia

Increasing quantity of relatively low-inertia generation coming onto system (e.g. wind) → system frequency drops faster in response to an event

Range of potential options to incentivise generators to provide inertia (noting that some wind plant can be built to deliver 'artificial' inertia)

- Paying for inertia delivered by reserve providers (which could be easily facilitated via area-under-the-curve)
- Allocating some proportion of IR costs to generators who don't provide IR
- Altering some generator AOPOs to require certain inertia characteristics

Over-frequency issues

Current over-provision of IL and AUFLS raises risk of system frequency *over*-shooting following triggering of such UFM resources, which could lead to generators tripping-off leading to collapse.

Considering range of options:

- Introduce compliance arrangement which penalise over-delivery of IL & AUFLS.
  - May be costly as would likely deter many providers
- Procuring over-frequency arming (OFA) from generators
  - Potentially less costly as OFA is being procured anyway to cover potential loss of DC bipole

Enabling wind to offer IR

Some parties have suggested rules should be changed to allow wind to offer IR

Initial considerations suggest net benefit may not be great

- Not clear that wind would provide much IR
- Potentially have significant system / market implications (e.g. may require wind be dispatched) and associated costs

Currently working through issues and options to determine whether to progress further