

Under Frequency Management

Proposed Project Brief

Airin Alamsjah
28 January 2011



*24 hours a day, 7 days a week
co-ordinating New Zealand's
power system*

SYSTEM OPERATOR

Keeping the energy flowing

TRANSPower



TABLE OF CONTENTS

1.	BACKGROUND.....	3
2.	OBJECTIVE AND SCOPE.....	3
3.	METHODOLOGY	4
3.1	WORK STREAM 1: INSTANTANEOUS RESERVES	4
3.2	WORK STREAM 2: AUFLS STAGE II	4
3.3	WORK STREAM 3: AOPOs AND PPOs	5
3.4	WORK STREAM 4: COLLECTIVE REVIEW	5
4.	DELIVERABLES.....	5
5.	TIMETABLE.....	6
6.	RELATED PROJECTS	6
7.	COMMUNICATION	6



1. Background

Robust under frequency management plays a significant role in operating a secure and cost efficient power system. Poor management can lead to high procurement costs of frequency management products, inefficient demand interruption, or, in the worst case, cascade failure of the system. The current under frequency standards are achieved mainly through a combination of mandated generator and HVDC owner obligations, procurement of instantaneous reserves (IR) and mandated automatic under frequency load shedding (AUFLS) obligations.

The System Operator has recently completed and presented a technical review of the current AUFLS arrangements. The review identified that the current AUFLS scheme would require enhancement for optimal operation in the event of significant system disturbance. The review also demonstrated the need to re-evaluate the present reserve market and to seek faster operating reserve products that also interact well with AUFLS.

Investment in grid infrastructure, in particular HVDC Pole 3 and the new technologies considered in proposed generation investments, further underline the need for a review of the current reserve arrangements and the opportunities to create a national reserve market. In addition, the increasing number of generators with little or no inertial contribution also necessitates a review of the existing operating standards and practices to ensure they are appropriate.

All of these complexities have led to questions over whether the current arrangements for managing under-frequency events are appropriate and optimal. The arrangements in questions include the following:

- the suitability of current instantaneous reserve products
- the amount of instantaneous reserves procured
- current AUFLS availability and arrangement
- asset owner's and HVDC owner's obligations
- under frequency standards set out in the Reserve Management Objective (Schedule 8.4 of the Code)

The disestablished Common Quality Advisory Group carried out a study on potential under frequency development work using an evaluation framework which included a quantitative analysis. The assessments projected that an under frequency management project is estimated to have an indicative net benefits value ranging between \$17m to \$73m, lower and upper bound respectively.

Consequently, in November 2010, the System Operator and Electricity Authority agreed that the System Operator would undertake a detailed review of the current under-frequency arrangements. The System Operator has undergone an initial scoping of the project and is seeking input from the Electricity Authority and industry participants on the contents of the scope detailed below.

2. Objective and Scope

The purpose of this review is to determine strategies and measures that offer the most reliable, secure and cost effective under frequency management model to provide greater certainty on system integrity during major under frequency events, and to operate an efficient market.

The project will primarily be aimed at the following:

- Evaluating the existing components and mechanisms of the current reserve market
- Investigating alternative technologies to improve the way reserves are procured and utilised

- Furthering the work from the AUFLS technical review in order to seek technically and economically viable arrangements that will ensure that frequency management products better meet the requirements of the power system
- Reviewing under-frequency performance objectives
- Reviewing asset owners' obligations.

This project does not include a review of the reserve cost allocation methodology. It is also important to clarify that any physical implementation of the recommendations is beyond the scope of this project. Any implementation will be dependent on the outcome of this project and would be delivered separately.

3. Methodology

The project will review the key areas that constitute under frequency management, each structured into various work streams described below. The System Operator will endeavour to undertake the work streams in parallel in order to minimise duplication of effort. However, due to the complexity of the issues, there is a strong degree of interdependency between each of the work streams that might require a coordinated iterative approach.

The following sections set out the associated activities the System Operator will carry out under each work stream.

3.1 Work Stream 1: Instantaneous Reserves

The purpose of this work stream is to examine the current reserve modelling and to consider alternative reserve products and/or arrangements that are better suited to manage New Zealand's reserve needs. In order to achieve these objectives, this work stream will require co-operation and direct inputs from industry participants.

This work stream includes:

- Studying historical contingent events to identify the reasons why the actual frequency response is often considerably different than the modelled outcome
- Reviewing and modifying (when deemed appropriate) modelling philosophy and assumptions employed in the existing reserve management tool (RMT) to make the modelling better reflect reality. In particular, we will look at FIR simulation time, net free reserve (NFR), hydro block dispatch, load models, and HVDC reserve sharing capability
- Researching opportunities and possibilities for other classes of reserve products that are technically feasible and investigate ways to accommodate for these in the reserve market
- Identifying, measuring and valuing the costs and benefits of the alternative solutions
- Studying technical feasibility of implementing a national reserve market
- Investigating changes in the market systems and any supporting rules that might be required as a result of the introduction of the new products and markets
- Identifying limitations in the current RMT and developing high level business requirements from which an investigation can be initiated
- Performing a cost benefit analysis of operating a national reserve market

3.2 Work Stream 2: AUFLS Stage II

The purpose of the AUFLS Stage II review is to recommend optimal arrangements for New Zealand and put forward draft set of code changes. This work stream includes:

- Identifying the economic and social consequences of under frequency events and analysing the costs and benefits of AUFLS versus black start
- Performing a cost-benefit analysis of the options so that the value of each can be better understood

- Completing a technical investigation of the options in order to present an optimal technical AUFLS arrangement (seeks input from Work Stream 3)
- Reviewing the regulatory requirements for AUFLS provision and exemptions
- Investigating the plausibility, implications, and requirements of creating an AUFLS market
- Investigating the implications of providing AUFLS and IL from the same feeders to discuss potential arrangements

3.3 Work Stream 3: Asset Owner Performance Obligations (AOPOs) and Principal Performance Obligations (PPOs)

Under frequency PPOs and AOPOs together form the foundation within which the System Operator operates the power system. These standards were largely influenced by historical levels of frequency quality which were directly related to the reliability of major assets connected at the time the standards were developed. Over time, as system configuration has changed, and will continue to change, there is a need to reassess the relevance of these operating standards. This work stream includes:

- Reviewing frequency envelope and frequency limits for an extended contingent event. This task involves communicating anticipated issues with relevant industry participants and identification of solution options (outcome feeds into Work Stream 2)
- Assessing cost implications (if any) as a result of implementing proposed solution from point 1
- Reviewing frequency limits for contingent event (seeks input from Work Stream 2 for North Island and from point 1 above for South Island)
- Reviewing asset owner, HVDC owner and embedded generation obligations, and independent action by generators and ancillary services agent

3.4 Work Stream 4: Collective Review

This work stream focuses on consolidating and analysing technical findings from Work Streams 1 – 3 and performing a cost benefit analysis of selected under frequency management model.

4. Deliverables

The key deliverables from this project include:

1. High level cost benefit assessment of the recommended under frequency management model
2. Recommendations for appropriate reserve products and AUFLS arrangements
3. Report addressing the key areas relating to the implementation of a national reserve market
4. Recommendations on appropriate PPOs and AOPOs that deliver the desired level of security in the most cost effective fashion. Note: Proposed code changes will have to meet the Electricity Authority's statutory objective and code amendment principles.
5. A set of high level requirements for a new reserve management tool that reflects the outcomes above

5. Timetable

Project milestones and an *indicative* timeline are provided below. This timeline may be impacted by the feedback received from industry and may be subject to change. We will keep participants updated of any changes.

Milestone	Date
Draft scope presented to the EA	December 2011
Draft scope released for industry comment	End of Jan 2011
Feedback on scope received from the EA and industry	End of Feb 2011
Finalised scope produced and published	March 2011
Initial results from reserve work stream presented to industry	End of Q2 2011
AUFLS recommendations presented to industry	End of Q2 2011
Feedback on reserves and AUFLS recommendations received	July 2011
Final results and recommendations presented to industry	Early Q4 2011
Final workshop	Mid-late Q4 2011

6. Related Projects

The following work is associated with this project:

1. Extended Load Control (ELC)
2. Wind Generation Integration Project (WGIP)
3. Normal Frequency Review

7. Communication

To ensure appropriate communication and consultation of project activities to wider industry, the System Operator plans to:

- communicate the draft project scope to the industry in January 2011, with the intention to involve industry participants as early as possible and to seek feedback on the content of the scope
- conduct facilitated session in quarter 1 and 2 of 2011 with selected participants to further discussion on particular topics required to move the project forward
- publish the finalised project scope and the indicative timeline for future session on the system operator website in March 2011
- present the results from AUFLS technical and economic study and initial findings from reserve work stream in June 2011
- hold a follow up presentation of final results and recommendations in October 2011. This is purposely scheduled after the Rugby World Cup has ended.