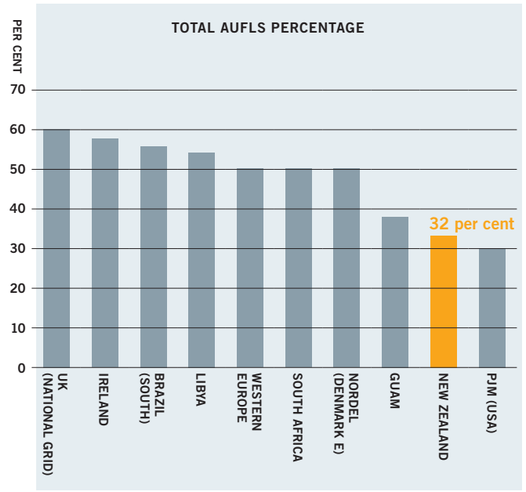
HOW WE COMPARE INTERNATIONALLY

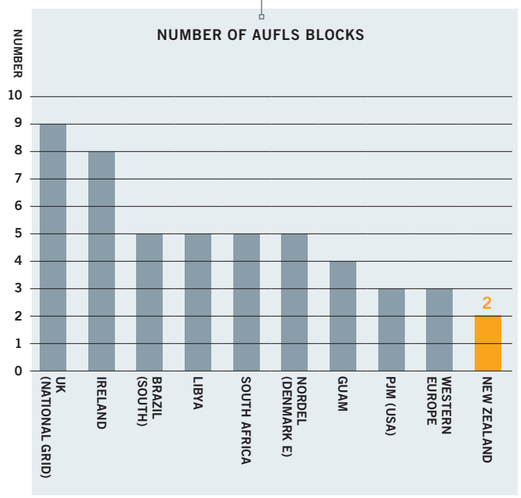
As part of the System Operator's review, New Zealand's current AUFLS scheme was benchmarked against those of other countries.

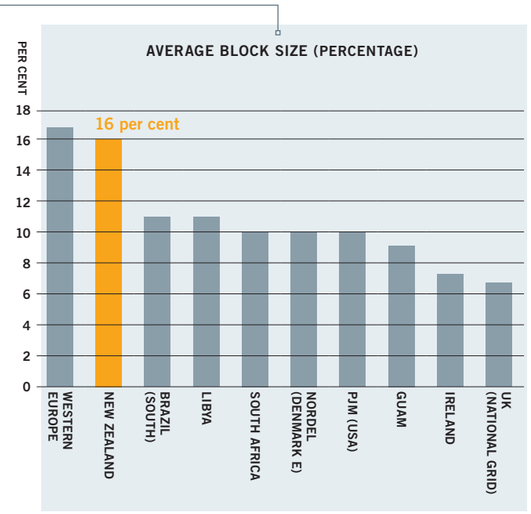
To have an effective AUFLS scheme, three key factors (see below) need to be considered as a total package and the cost of this needs to be weighed against the risk to the industry and New Zealand as a whole.

1 / HOW MUCH LOAD CAN WE SHED?
Compared to other countries, the total size of New Zealand's AUFLS is relatively low. New Zealand has a 32 per cent AUFLS scheme.

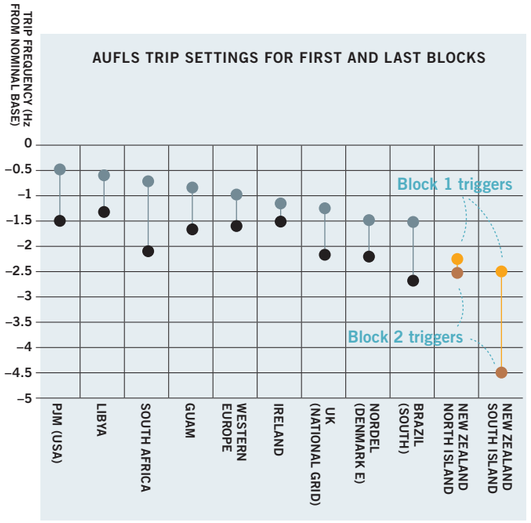


2 / HOW MANY BLOCKS?
Overseas systems have more AUFLS blocks that are smaller in size. This allows more control to manage the frequency after an event. New Zealand's AUFLS scheme is made up of two 16 per cent blocks.





3 / HOW FAST CAN THEY BE SHED?
New Zealand's AUFLS trip settings are relatively low compared to other countries. The North Island's AUFLS trip settings are too close together to be effective.



Keeping the energy flowing

AUTOMATIC UNDER-FREQUENCY LOAD SHEDDING (AUFLS)

SYSTEM OPERATOR — TRANSPOWER

SUMMARY TOOL

This summary tool provides you with an overview of what AUFLS is, how it works in New Zealand, how we compare internationally, and an introduction into the AUFLS technical report (August 2010).

WHAT IS AUFLS?

AUFLS is the New Zealand power system's last-resort 'safety net' to prevent power system collapse and island-wide power outages following rare, large system events.

It is important that power supply is balanced with consumer demand at all times to ensure stability of the power system. When there is a large, unexpected loss of generation, AUFLS is used to restore stability to the power system. This means that on rare occasions a minimum of 32 per cent of consumer demand can be automatically disconnected to prevent further power outages across the North or South Island.

EXECUTIVE SUMMARY

The AUFLS technical report has found the following about New Zealand's existing AUFLS scheme.

- It is sufficient to recover the system from identified events known as extended contingent events. However, operational restrictions on power system equipment are required to ensure that the AUFLS 'safety net' can meet the risk. There is also the potential for serious over-voltage issues in the North Island following an AUFLS event.
- AUFLS is likely to be ineffective at recovering the system from a number of large unidentified events. While these are low-probability events, they are high impact, and therefore it is critical that we continue to plan for the unexpected.

The System Operator has identified that there are significant benefits to be had by improving the existing AUFLS scheme to further enhance and secure New Zealand's power supply. However, discussion around these improvements must involve the industry and be balanced against the costs and risks to the industry and New Zealand consumers. The key issues from the AUFLS technical report to be considered include:

- looking at possible redesigns of the current AUFLS system to improve its performance
- looking at the potential for new services to be created to further secure New Zealand's power supply.

The System Operator will also communicate and coordinate any actions needed to address the potential over-voltage issues in the North Island as a matter of priority.

HOW AUFLS WORKS

The System Operator maintains the security of New Zealand's power supply 24/7. To do this, generation must be constantly balanced with customer demand. It is a see-sawing exercise, working in real time to maintain our power system at a frequency of 50 Hz. In a normal working day, generation output is readjusted every five minutes to meet customer needs.

Events can happen, though, that threaten security. For example, the HVDC link could have a technical issue that caused it to disconnect suddenly. We have contingencies for these events. AUFLS is one of these and is our last backstop. This diagram explains step-by-step how it would work in a major North Island event.

ANNUAL PROCUREMENT COST
2009/2010 FINANCIAL YEAR

Frequency keeping	$55.6 million
Generator reserves	$18.5 million
Interruptible load	$15.3 million
AUFLS	N/A – this is a mandated scheme
Blackstart	$460,000

TRANSPOWER

NORMAL OPERATION
- When power supply = customer demand, the power system is balanced at 50 Hz.
- Selected power stations vary output to maintain the frequency within 49.8–50.2 Hz. This service is known as **frequency keeping**.

WHEN A MAJOR EVENT OCCURS
- Loss of generation will cause the frequency to fall.
- Balance can be restored by increasing generation and/or decreasing demand.

INSTANTANEOUS RESERVES ACTIVATE
- **Generator reserves** are procured to be on standby and will respond within 2–4 seconds.
- **Interruptible load** is procured to disconnect the power to selected customers. It triggers at 49.2 Hz and takes up to 1 second to respond.

AUFLS ACTIVATES
- **AUFLS** Block 1 triggers at 47.8 Hz and takes 0.4 seconds to respond. Power supply is disconnected to 16 per cent of customers across the island.
- **AUFLS** Block 2 triggers at 47.5 Hz and a further 16 per cent of customers are disconnected.

TIME IS CRITICAL
- The frequency can drop to 47 Hz within 2–3 seconds.
- 24 per cent of generators will trip (automatically disconnect) at 47 Hz.

SYSTEM UNBALANCED
- Activating AUFLS helps to restore the balance of power supply with customer demand.
- But disconnecting too much demand (AUFLS) will cause the frequency to rise above 50 Hz.

BALANCE RESTORED
- The System Operator carefully coordinates restoration of power to affected customers.

If the AUFLS scheme is ineffective:
- *the frequency may continue to rise*
- *most generators will start to disconnect above 52 Hz*
- *there will be no AUFLS 'safety net' left to fall back on.*

If the AUFLS scheme is ineffective:
- *the frequency may continue to fall*
- *all generators will disconnect below 45 Hz*
- *the System Operator will immediately initiate the **Blackstart** process*
- *it will take a minimum of 12 hours to restore power fully as generators and customers are carefully reconnected back onto the grid.*

AUFLS RANGE

FREQUENCY (Hz): 53, 52, 51, 50, 49, 48, 47, 46

TIME (SECONDS): 0, 10, 20, 30, 40, 50, 60