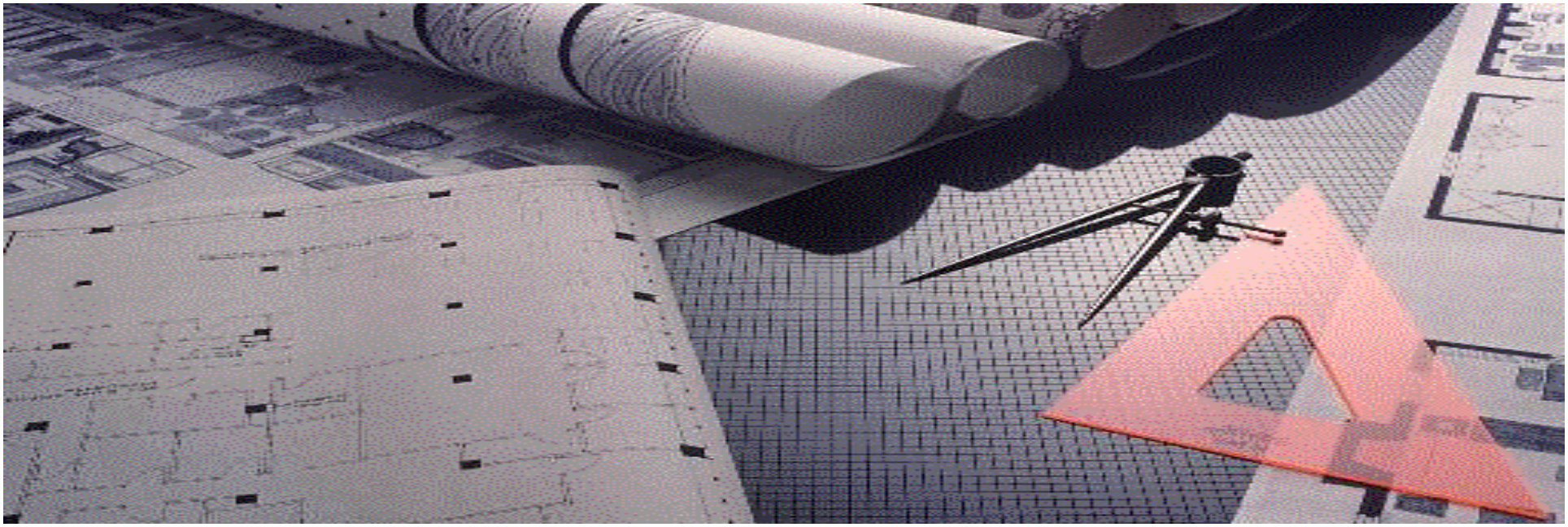


System Reserve Policy

Michael Preston SONI
Peter Brown EirGrid

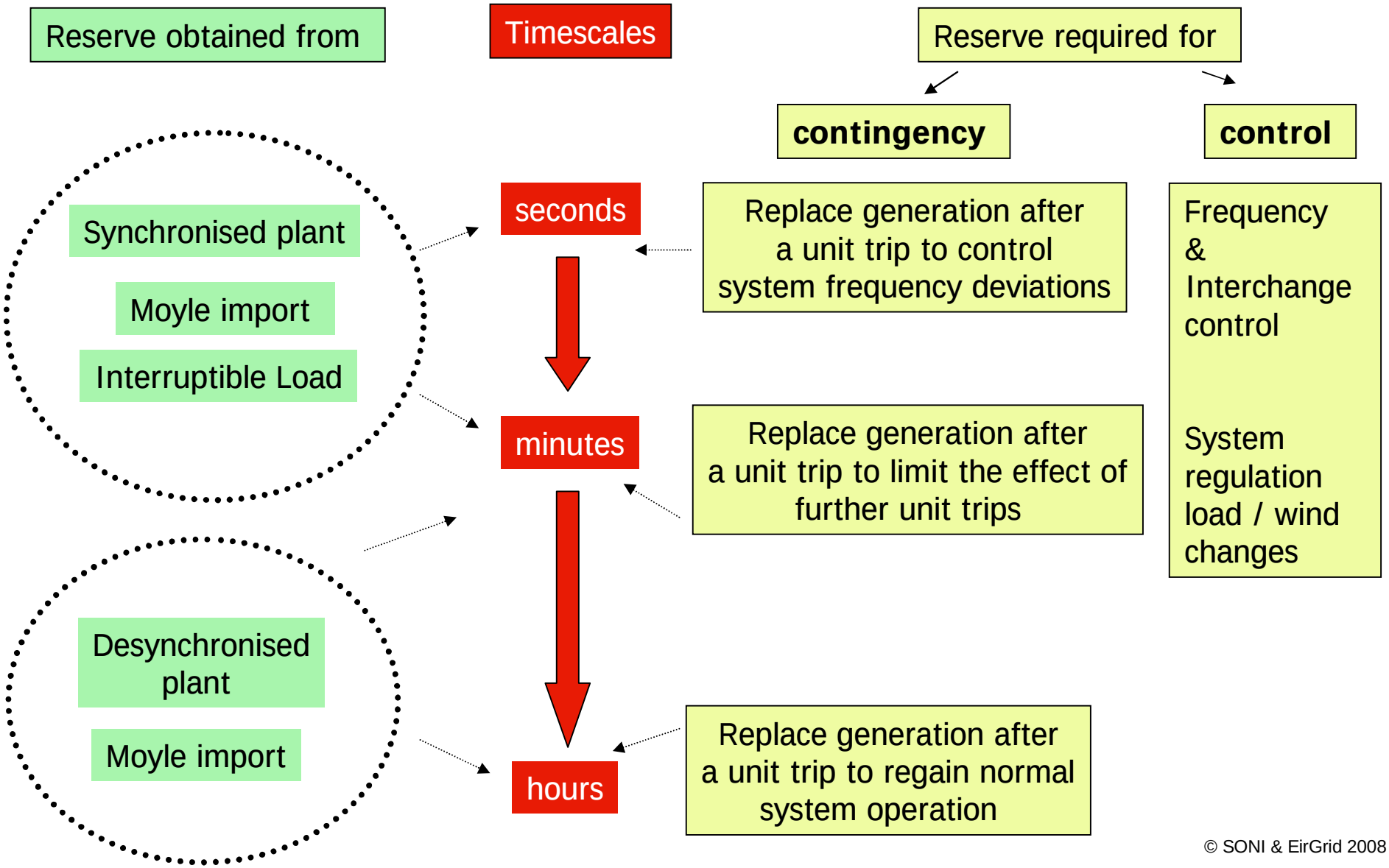
Overview

- Reserve is provided to ensure security of supply and permit control of the system

- Reserve is provided in different time frames to secure against system contingencies

- The Grid Codes provide various definitions of reserve types that reflect and balance the system requirements for reserve and general plant capabilities for provision of reserve.

Overview



Reserve requirements

These contingencies require reserve in the time period 5 seconds post event to 20 minutes post event

(If another contingency occurs within this time period the power system is secured by automatic low frequency load shedding)

Primary Reserve

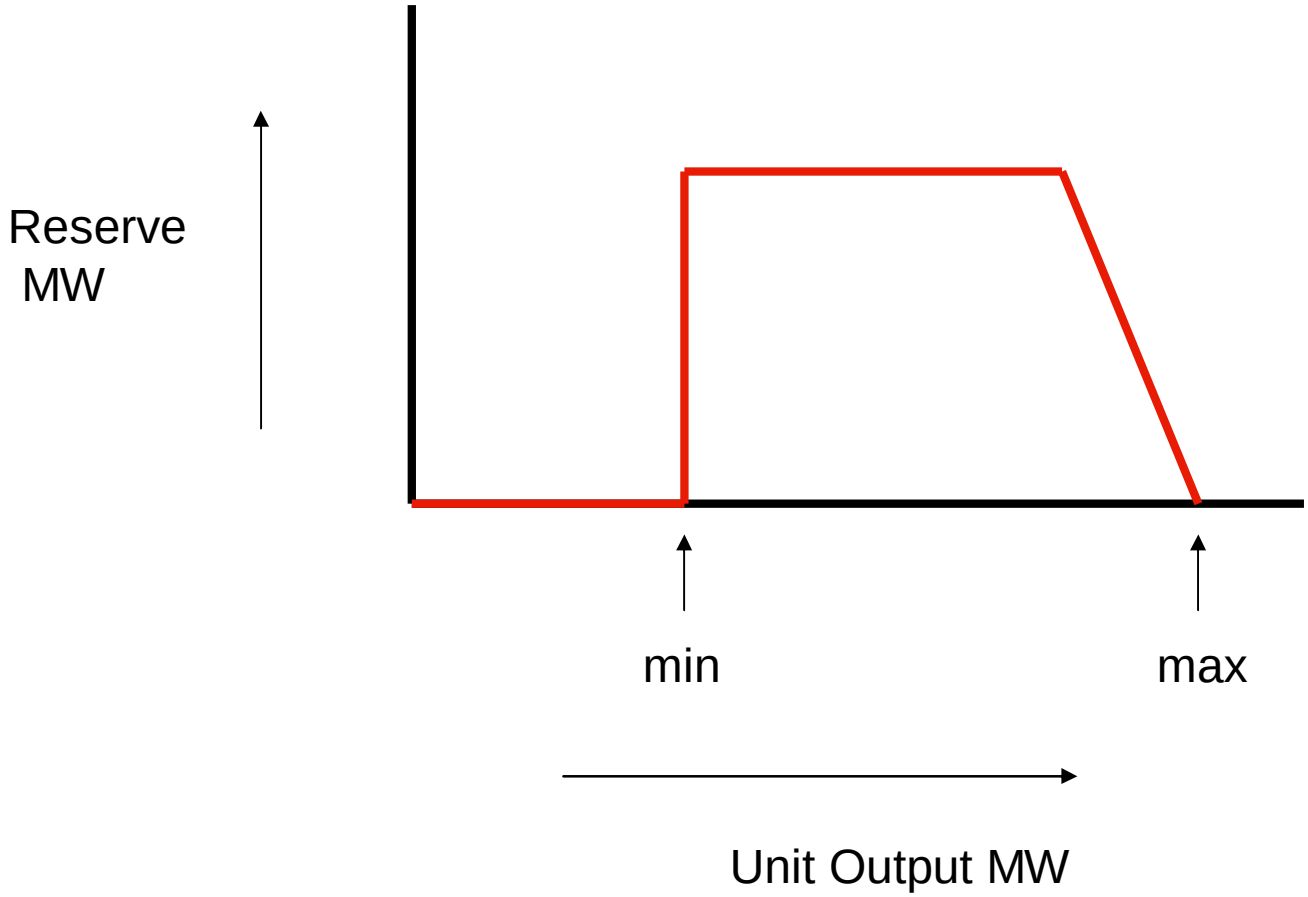
Secondary Reserve

Tertiary Reserve 1

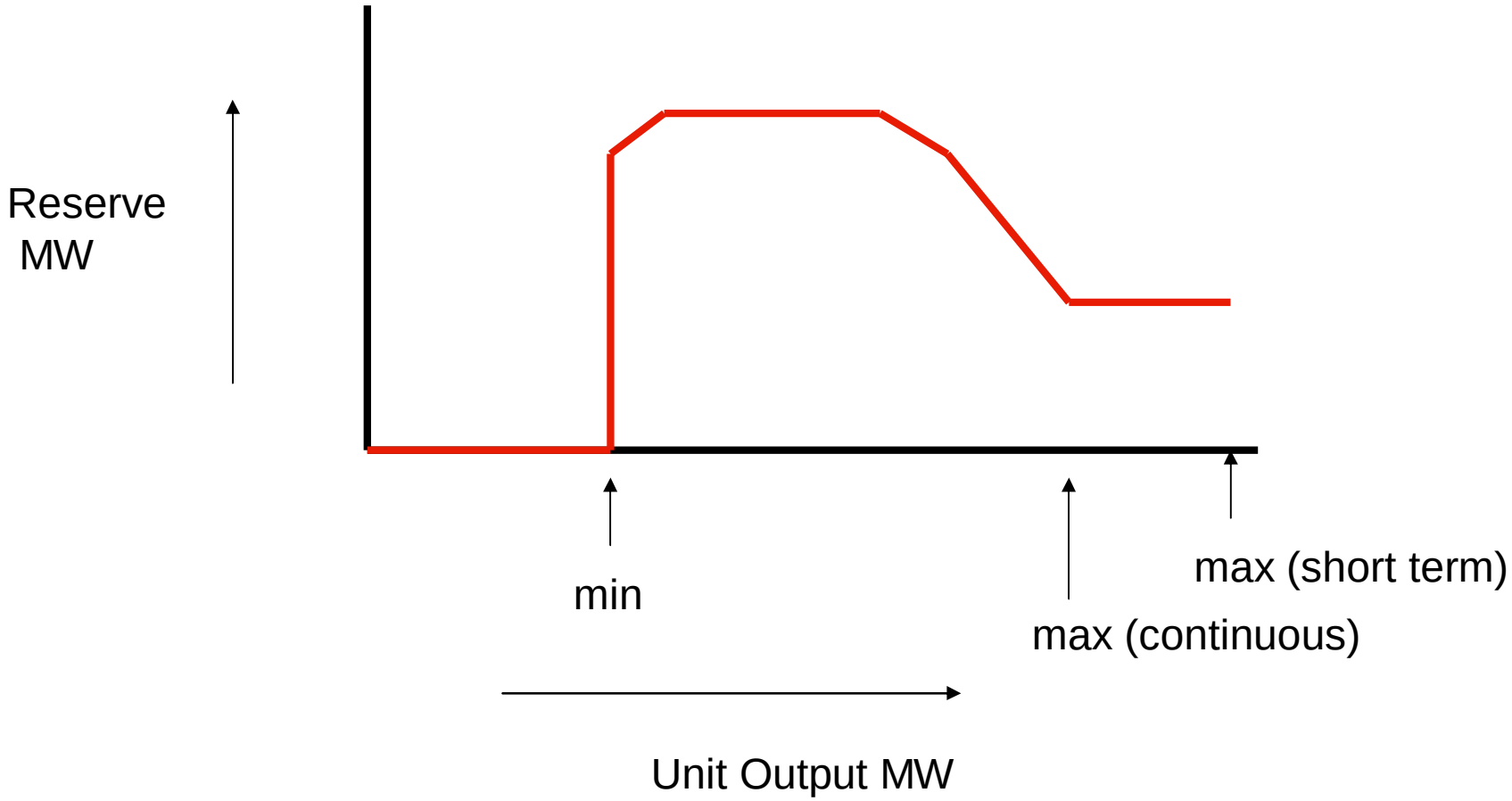
Tertiary Reserve 2

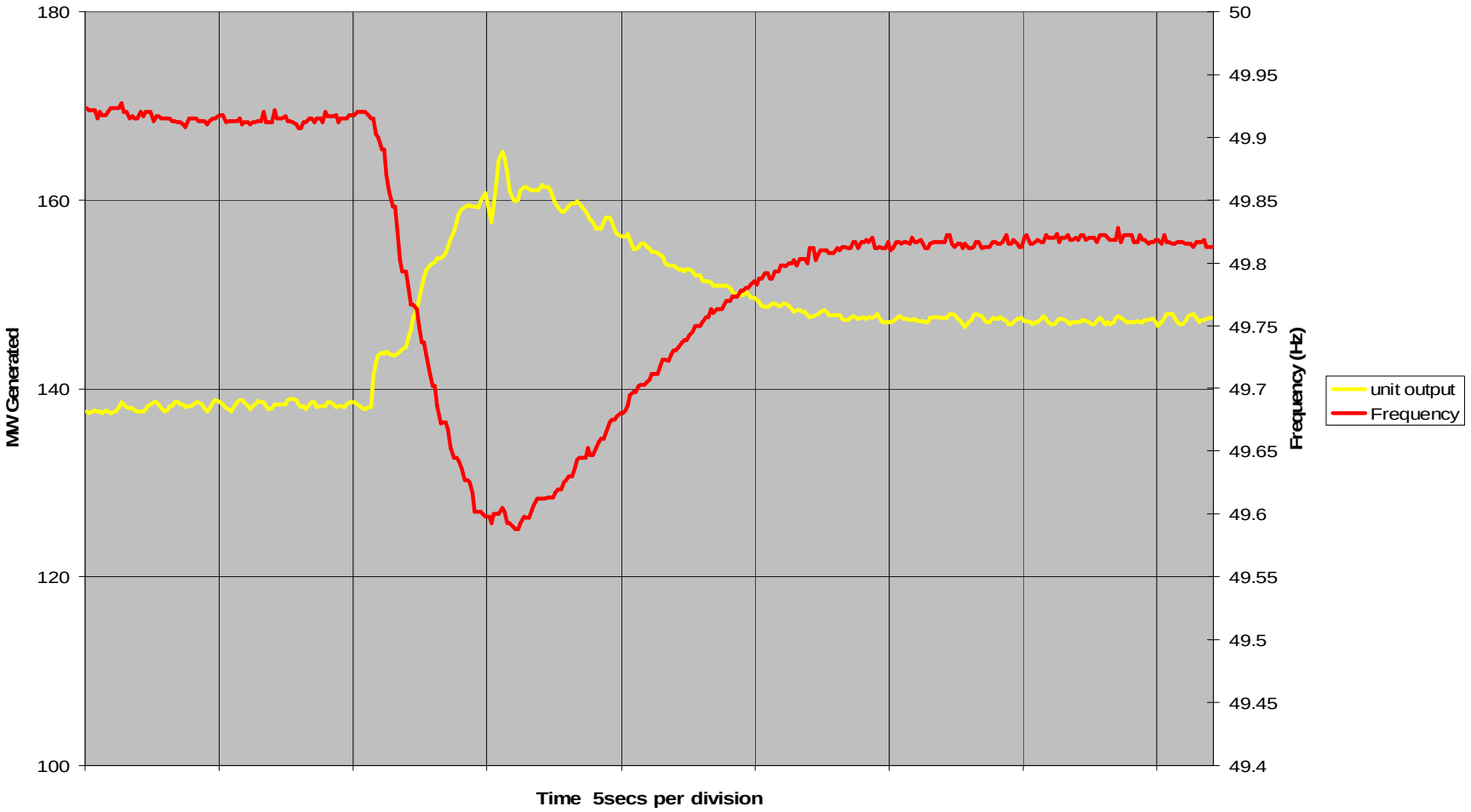
- Power system to remain stable after the loss of a large generation source
- Power system frequency nadir to be limited to 49 Hz and to recover to more than 49.5 Hz within one minute after the loss of a large generation source
- To allow regulation of the system frequency as load and non dispatchable generation moves around
- To allow control of the synchronous transfer across tie lines
- To allow synchronising of quick start plant

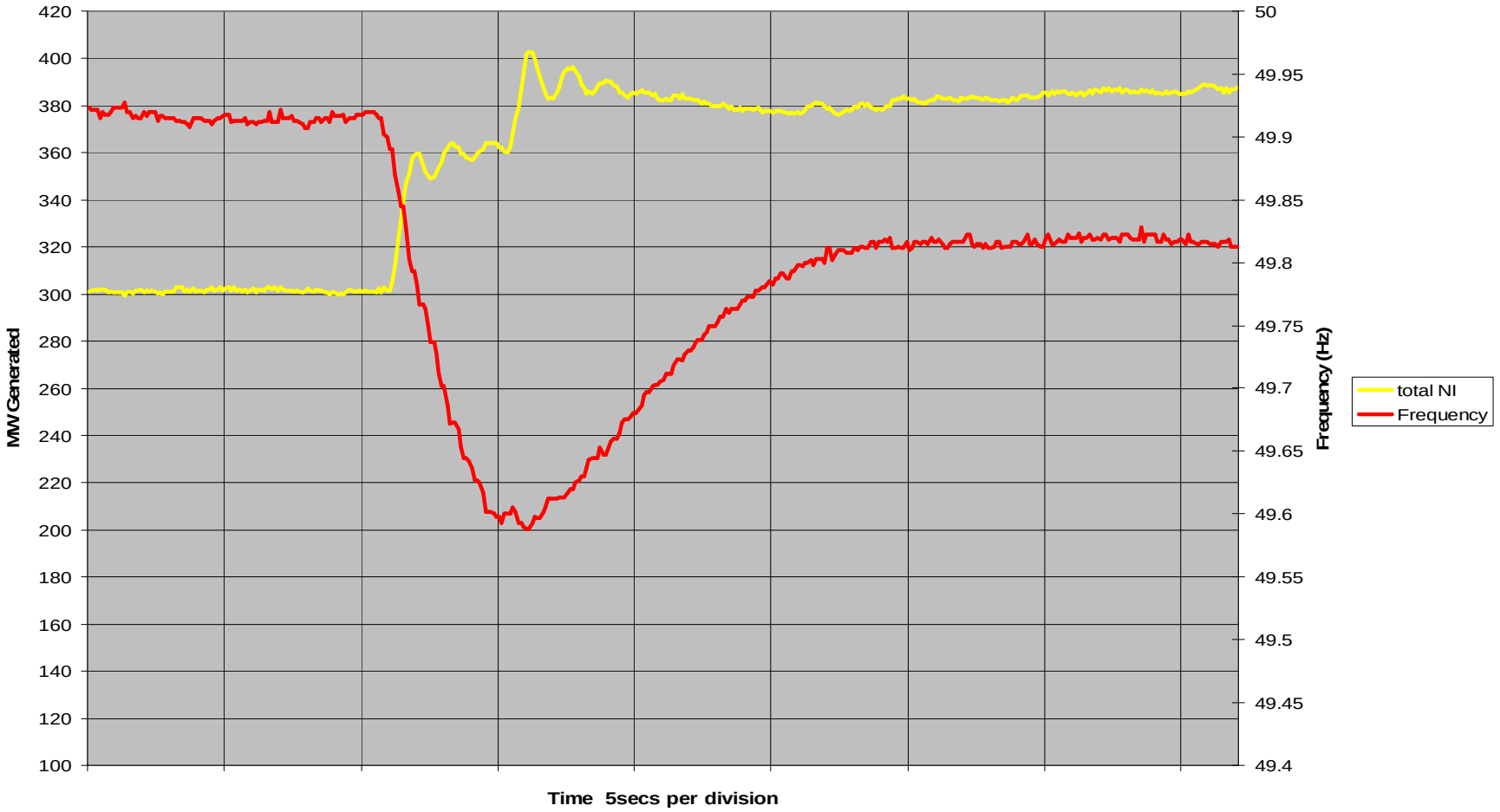
Typical Unit Primary reserve characteristic



Kilroot Primary reserve characteristic







Reserve requirements

Negative Reserve

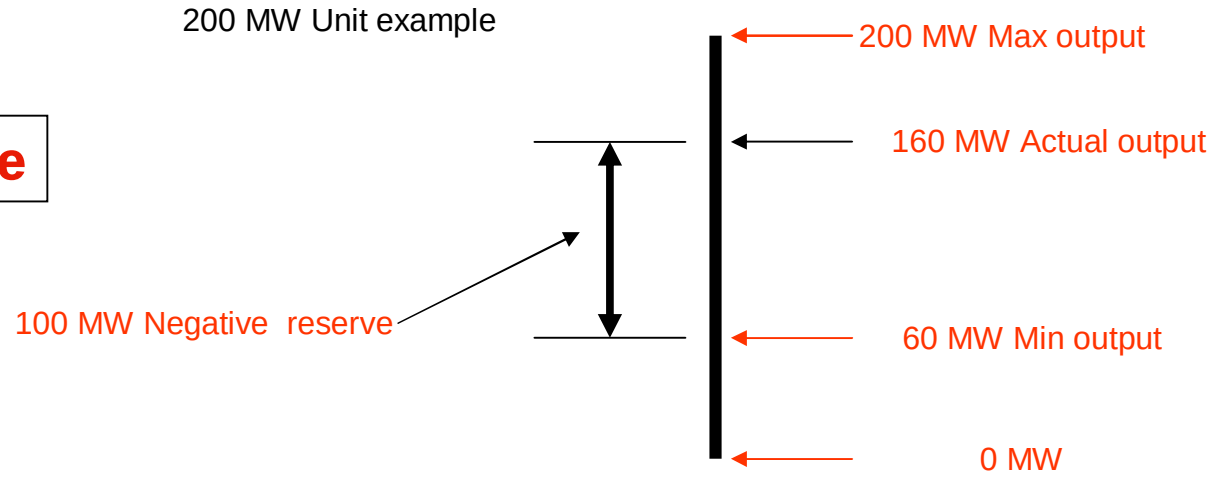
With increasing wind generation on the island the concept of Negative reserve was introduced to plan and monitor for unexpected increases in non dispatched generation.

The negative reserve is the difference in the running output of the machines and their minimum output.

Collectively this represents the ‘head room’ there is at any one point in time for the system to absorb increasing non dispatched generation.

Reserve requirements

Negative Reserve



For example-

The total generation scheduled may be 4000 MW and without taking units off reducing the unit outputs to minimum could reduce the total output to 3300 MW . There is therefore 700 MW of negative reserve available.

If the non dispatched generation was capable of increasing by more than 700 MW additional operator action is required.

Reserve requirements

Replacement Reserve	20 min post event to 4 hrs post event
Substitute Reserve	4 hrs post event to 24 hrs post event
Contingency Reserve	Fully available D+1

- To restore sufficient quick acting reserve to allow the system to remain stable after the loss of another large generation source
- To restore system frequency to the normal operating range
- To restore quick acting and 20 minute to 4 hour reserve to regain normal system operation
- To manage the running of energy or emission restricted plant
- To allow control of system frequency and transfers following changes in non dispatchable generation

RCUC produces an optimised Unit Commitment schedule for the island

RCUC co-optimises the provision of energy and the following four reserve categories

- **Primary**
- **Secondary**
- **Tertiary 1**
- **Tertiary 2**

The other reserve categories are calculated by RCUC but not used in the optimisation

- **Replacement**
- **Substitute**
- **Contingency**
- **Negative**

Reserve Requirements Primary, Secondary and Tertiary

RCUC schedules units to provide reserve for the island at minimum system cost based on individual unit reserve characteristics respecting –

1) A jurisdictional minimum primary reserve holding for SONI

2) A jurisdictional minimum primary reserve holding for EirGrid

3) A total island reserve requirement determined from a fixed percentage of the Largest Single Infeed (LSI)

4) Tie line flow limits after reserve execution in either jurisdiction

5) A minimum requirement for dynamic reserve in both jurisdictions

Reserve Requirements Primary, Secondary and Tertiary

1) A jurisdictional minimum primary reserve holding for SONI

2) A jurisdictional minimum primary reserve holding for EirGrid

These values are fixed and are to -

- permit control of the tie line flows

- to avoid uncontrollable frequency falls in the event of system separation i.e. if the tie lines should trip

Present values are

SONI – 50 MW

EirGrid – 100 MW

Reserve Requirements Primary, Secondary and Tertiary

3) A total island reserve requirement determined from a fixed percentage of the Largest Single Infeed (LSI)

The loss of the LSI is the event planned for when quantifying reserve provision.

The LSI includes the Moyle import.

If reserve is being carried on the LSI, this reserve is not included in reserve totals

RCUC will reduce the output of the LSI source if it is a cheaper solution than providing additional reserve.

The balance of the reserve requirement (total minus jurisdictional minima can be optimised and scheduled in either jurisdiction)

Present values are -

Primary	75% LSI	Secondary	75% LSI
Tertiary 1	100% LSI	Tertiary Reserve 2	100% LSI

4) Tie line flow limits after reserve execution in either jurisdiction

Tie line flows in both directions have physical limits, the maximum flow that can be sustained without breaching system security rules (line overloads, voltage limits etc) after a credible transmission event.

The limits are referred to as the Total Transfer Capacity (two values one N-S and one S-N).

When determining minimum system cost, RCUC respects the TTC values by not allowing the reserve holding in either jurisdiction + the tie line flow to exceed the TTC.

Present values	N-S TTC	450 MW
	S-N TTC	440 MW

Reserve Requirements Primary, Secondary and Tertiary

Dynamic →

- Synchronised units operating at less than maximum output
- Pump storage synchronised and generating

(inertia and governor action during frequency transient)

Static →

- Pump storage in pump mode
- Moyle interconnector
- Interruptible Load

(output change initiated by system frequency falling through a pre-set activation threshold

Reserve Requirements Primary, Secondary and Tertiary

5) A minimum requirement for dynamic reserve in both jurisdictions

The Moyle interconnector allows 50MW of reserve from NGC to flow into the power system when the frequency falls below 49.6 Hz.

This reserve provides no system regulating capability which is provided from the Primary reserve holding

If all the primary reserve was static, system frequency control would not be possible. RCUC respects the desired Static / dynamic requirements when optimising.

Present dynamic values	50 MW SONI
	100 MW EirGrid