OC3 Operating Reserves and Responses

Aznan Ezraie Ariffin

Grid Code Awareness Program

KeTTHA
KEMENTERIAN TENAGA, TEKNOLOGI HIJAU DAN AIR

Suruhanjaya Tenaga

The Malaysian Grid Code Awareness Programme Funded by Akaun Amanah Industri Bekalan Elektrik (AAIBE)

Contents

Intro, Objectives and Scope

- Describes the different types of reserves that make up the operating reserve that may be used in real-time
- Identify the parameters associated with operating reserves typically required
- Grid System required to be operated to account for:
  - Planned/Unplanned outages
  - Demand forecasting inaccuracies
  - Frequency regulation in changes in load
  - Loss of generation/demand
  - Voltage control requirements

Intro, Objectives and Scope (cont)

- Applies to GSO and the following users:
  - Single buyer
  - Generators with CDGUs
  - Distributors
  - Network Operators
  - Interconnected parties
  - Directly connected customers who have agreed to undertake demand control (see OC4)

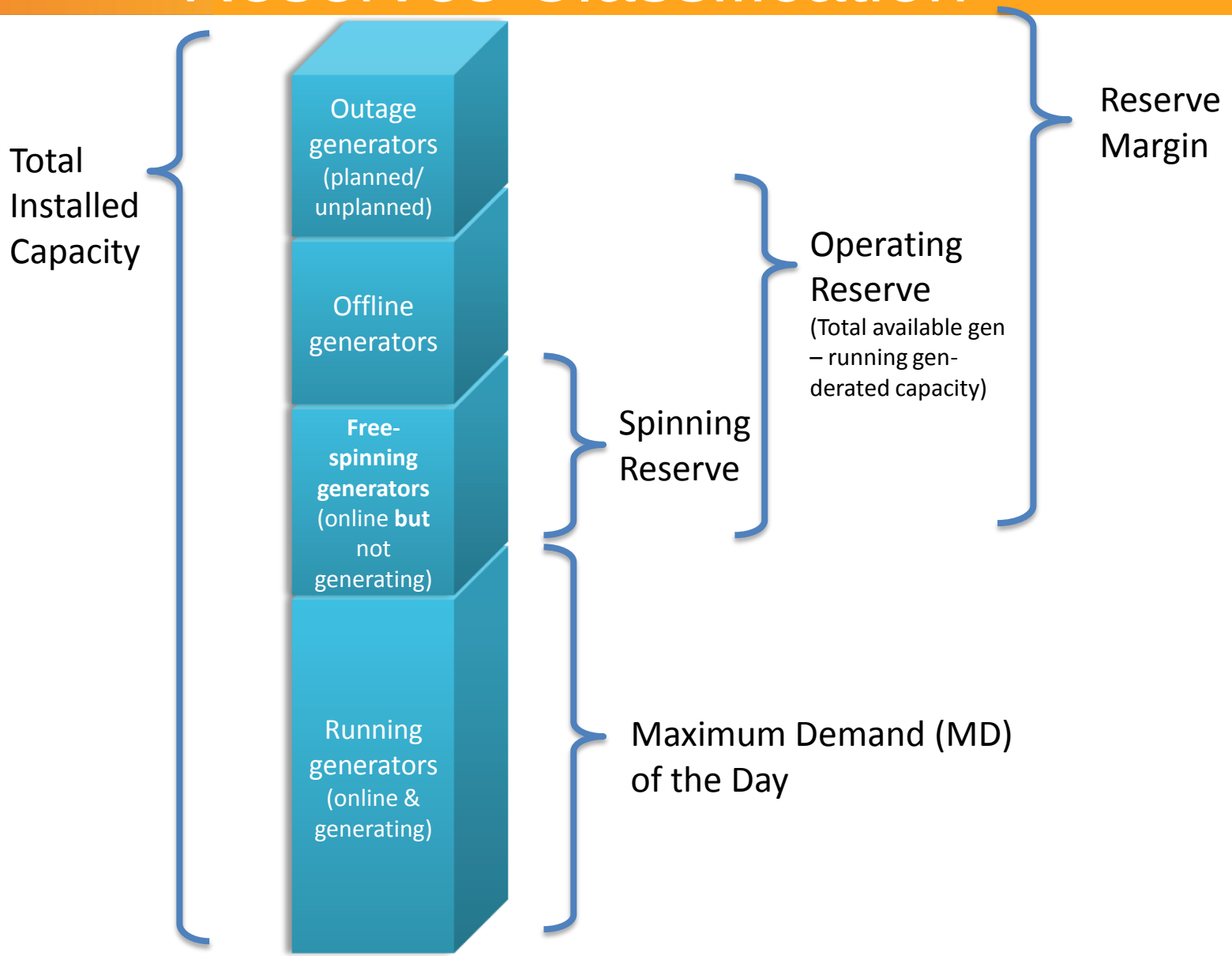
Operating Reserves and Its Constituents

- GSO shall match the generation output to Demand forecasts (OC1) plus Operating Reserve
- Two types of Operating Reserve (OR):
  - Spinning Reserve (SR)
  - Non-spinning Reserve (NSR)
- Shall be tested from time to time (OC10) and essential for stable operation

Operating Reserves and Its Constituents (cont)

- Spinning reserve is realisable in real time consisting of:
  - Additional output from synchronised Generating Units
  - Imports through Interconnected systems
  - Provided for by demand
- To arrest a drop of system frequency and capable of restoring frequency deviation to an acceptable level due to:
  - Loss of generation
  - Loss of external interconnector
  - Mismatch between generation and demand

Reserves Classification



Spinning Reserves and Responses

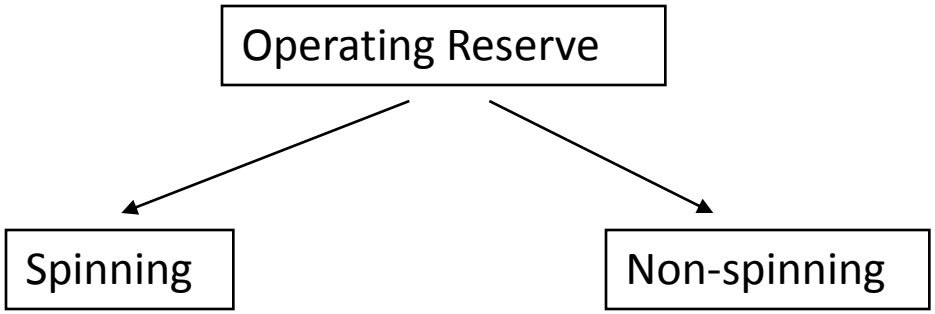
- The additional MW output is categorised in according with its realisable time from the time of frequency change:
  1. Primary response: fully realisable within <= 10 seconds of a frequency change and fully sustainable for a further <= 20 secs
  2. Secondary response: fully realisable within <= 30 seconds of a frequency change and fully sustainable for a further <= 30 mins
  3. High Frequency: released over 10s period

Spinning Reserves and Responses (cont)

4. Demand following by AGC: generation and demand automatic error reduction mechanism employed by NLDC
5. Interconnector Transfer Response
6. Frequency Change Demand Response
7. Demand Control Response
8. Declared maximum generation dispatchable
9. Interconnected parties Emergency Transfer
10. Within 30 mins Fast Response realisable
11. Hot or Warm standby units

Note that (7), (10) and (11) cannot be strictly categorised as Spinning Reserve but can contribute to total portfolio of Operating Reserve

New MGC Categorization



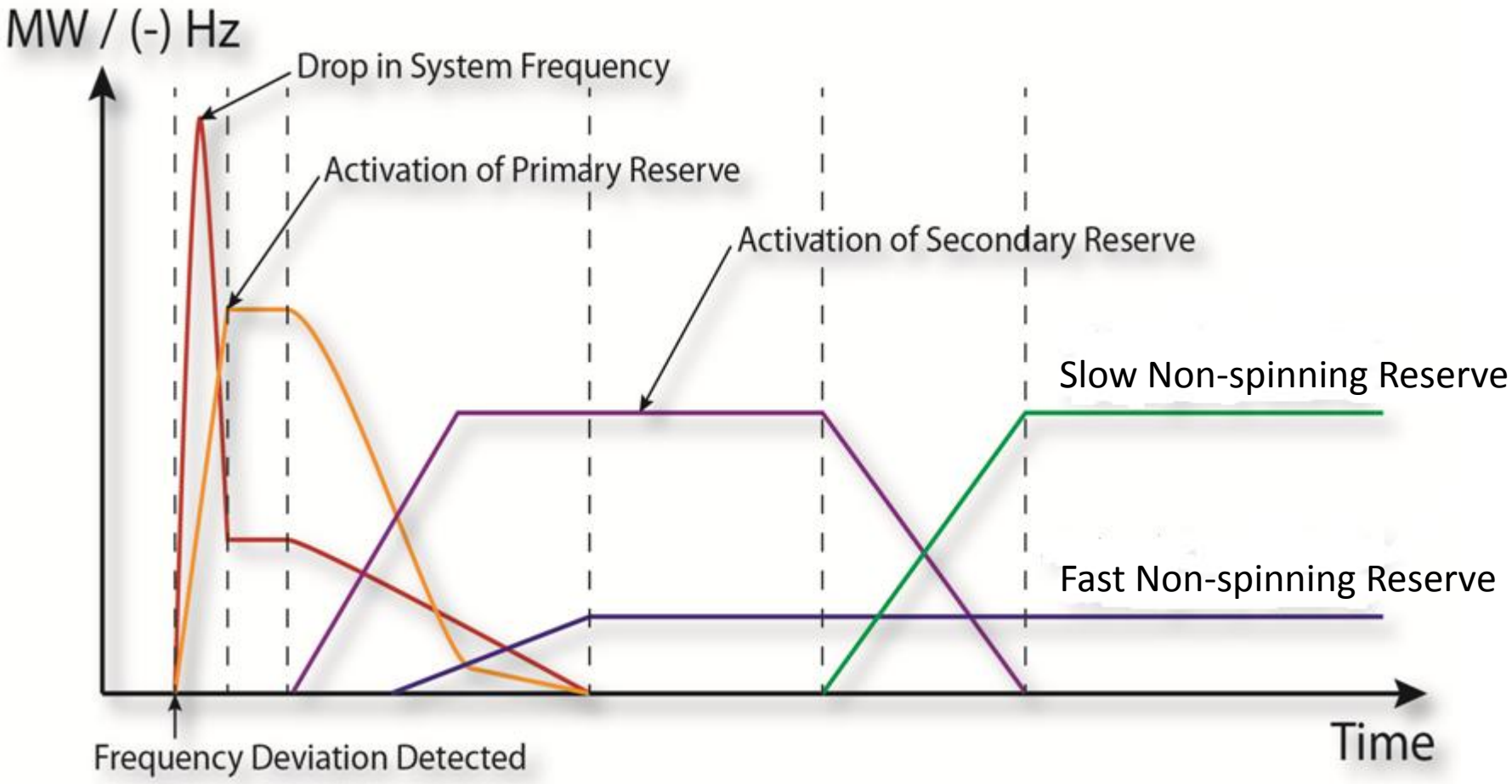
- Primary Response
- Secondary Response
- High Frequency Response
- AGC Demand Following
- Interconnector Response
- Frequency Change Demand Response
- Demand Control Response
- Maximum Dispatchable Generation
- Interconnector Emergency Response
- Fast Response within 30mins
- Hot or Warm Standby Units

- Hot or Warm within 1 hr
- Cold longer than 1 hr

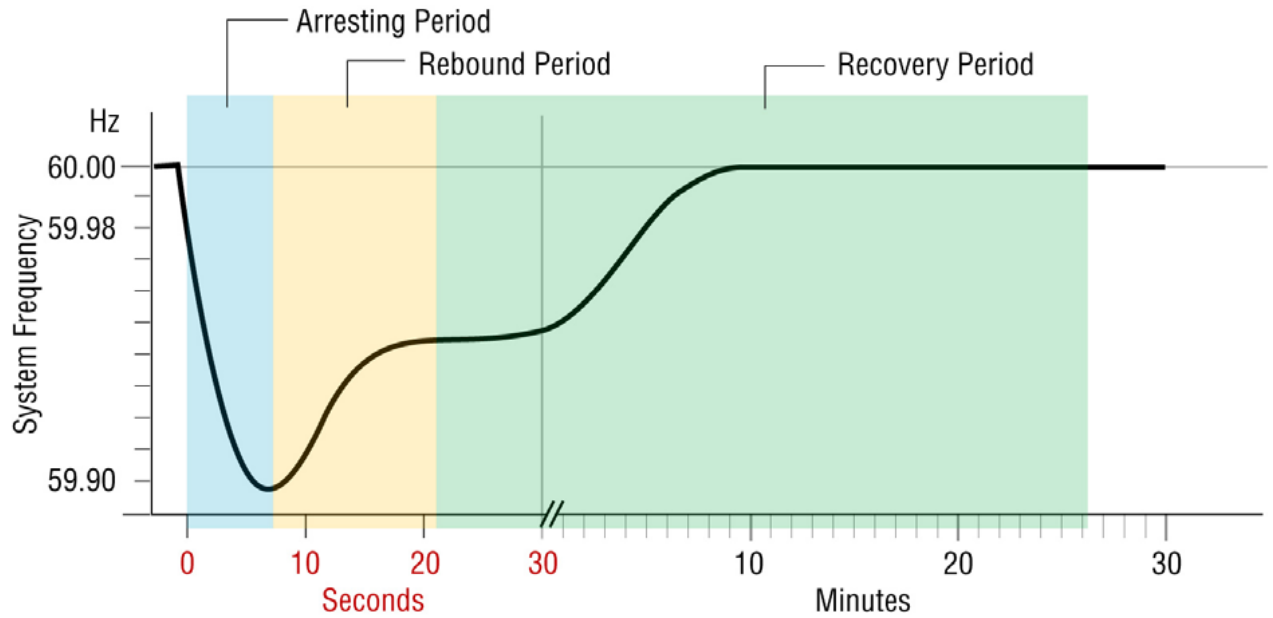
New MGC Categorization (cont)

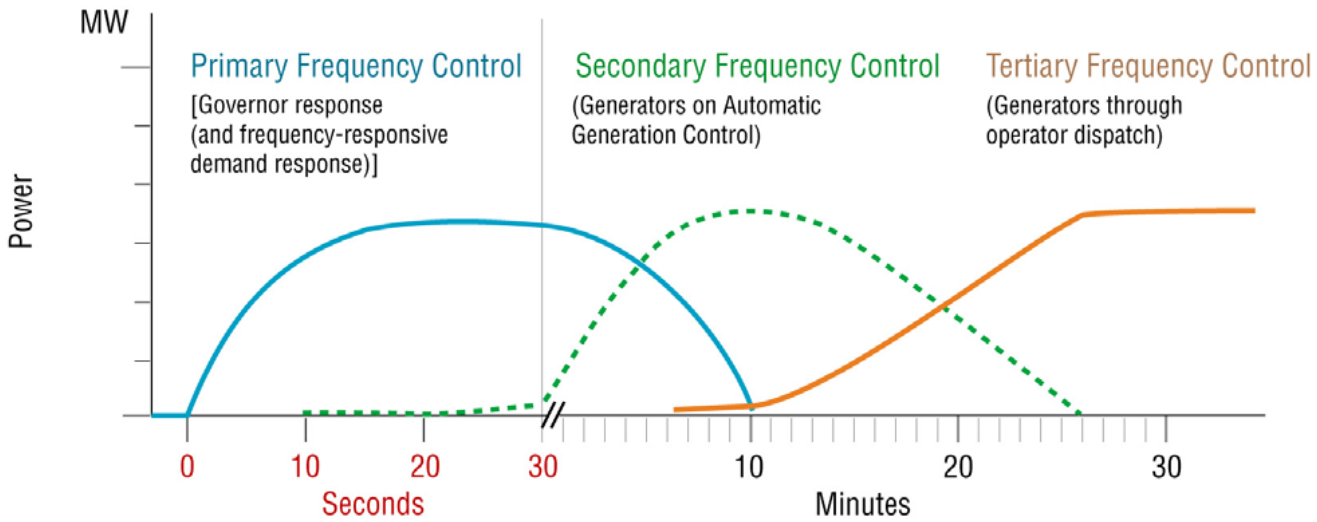
Spinning	Primary	Coal, Part-load hydro and GTs
	Secondary	Coal, Syncon hydro, ST of CC
	High Frequency	All
	AGC Demand Following	Those that are on AGC
	Interconnector Response	SPPG/EMA
	Frequency Change Demand Response	Motor loads
	Demand Control Response	In development
	Max Dispatchable Generation	All
	Interconnector Emergency	TNB-EGAT HVDC FLC
	Fast Response within 30mins	The remaining responses
	Hot or Warm Standby Units	Hot or Warm Standby Units
Non-spinning	Cold Standby Units	Within 1 hr
		More than 1 hr

Spinning Reserves and Responses

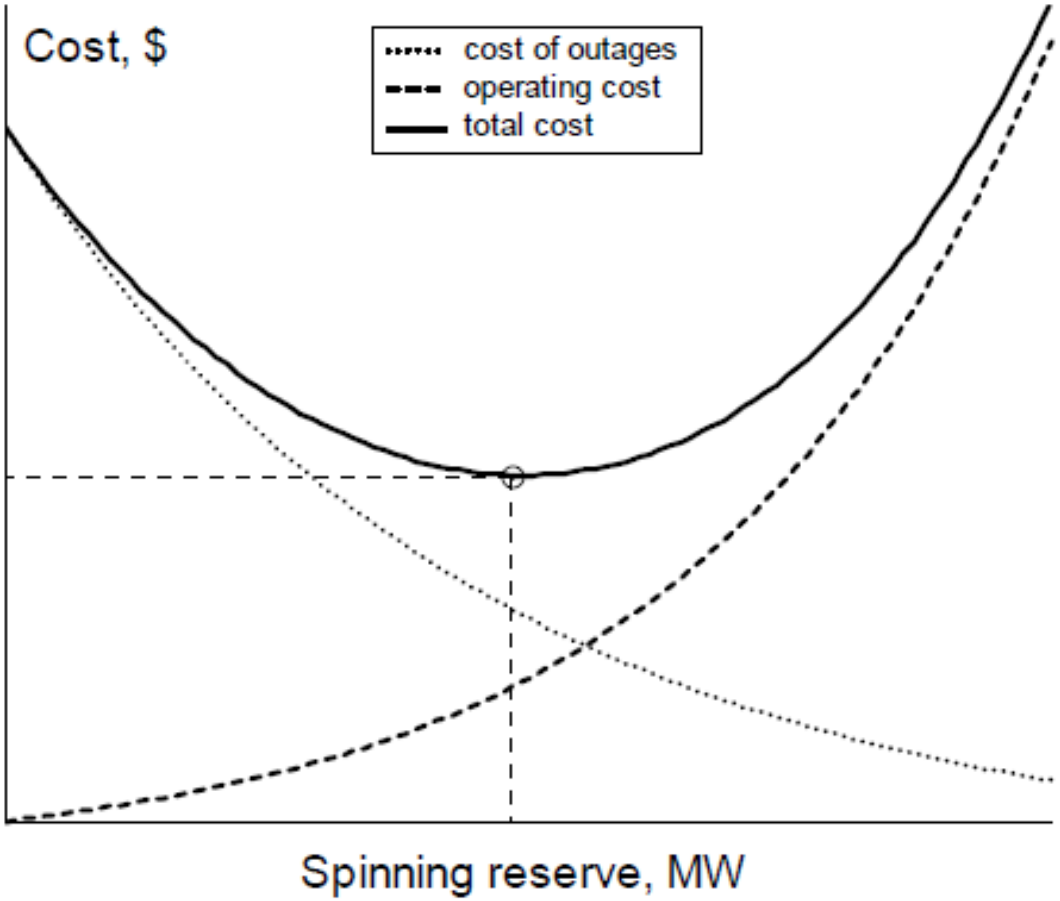


Frequency Deviation and Responses

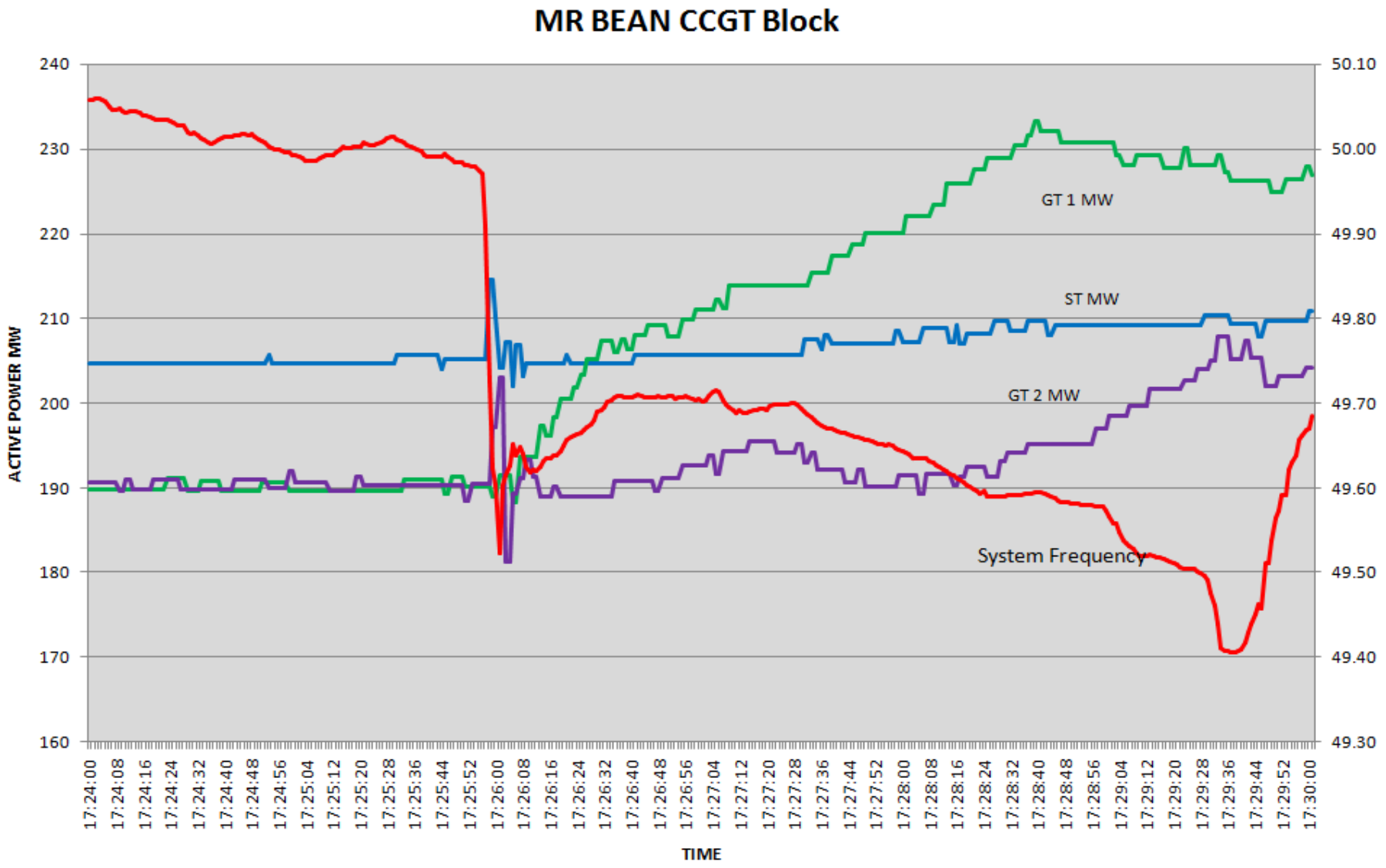




Cost of SR Procurement



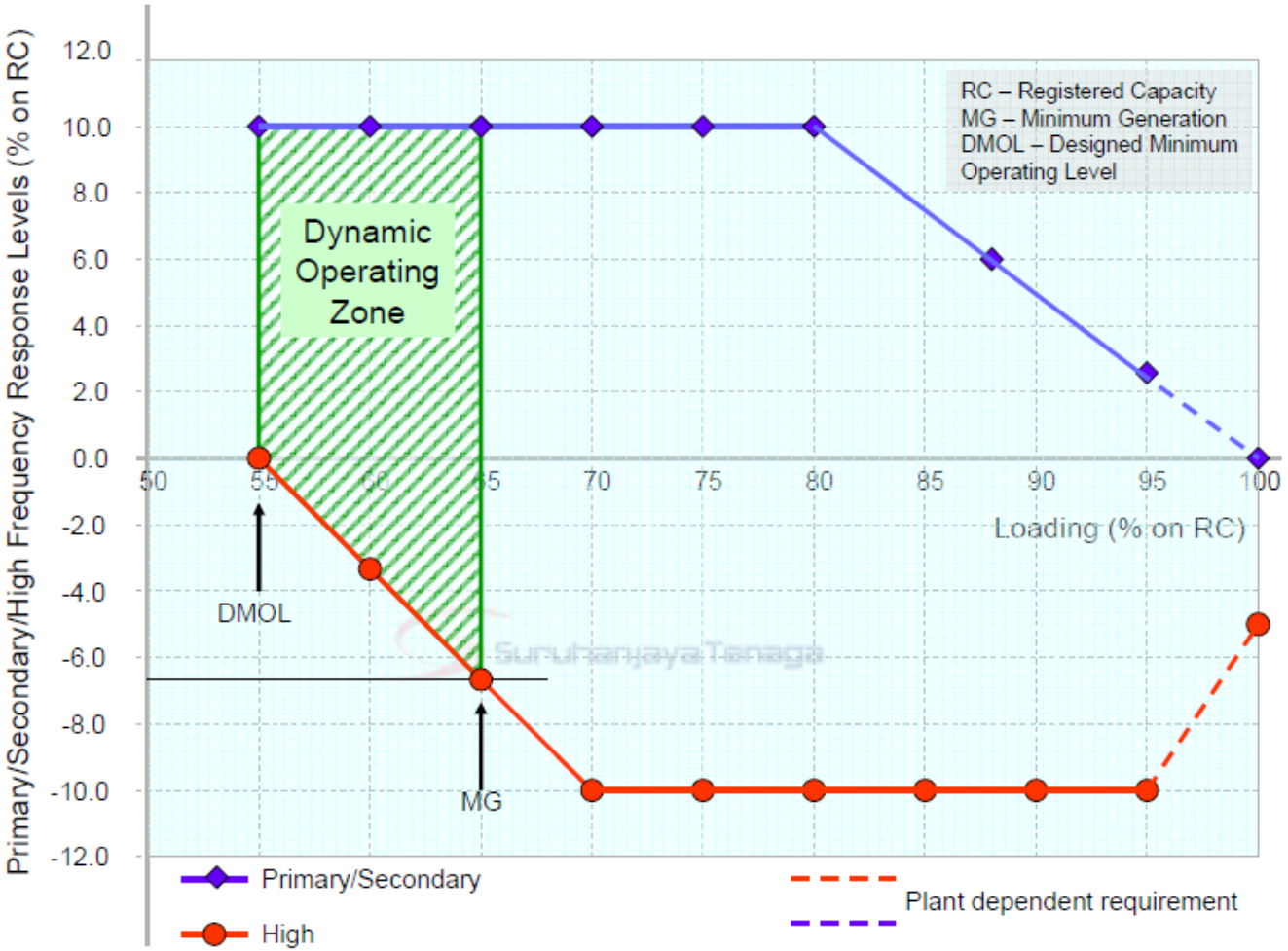
Real Example of Responses



Non-spinning Reserve

- Available output from Standby Generating Unit that:
  - Can be synchronised and loaded within 1 hr when the Generating Unit is warm or hot
  - A longer time-scale when the unit is cold to cater for abnormal Demand increase or further Generating Unit breakdowns

Minimum Frequency Response Requirement



Profile for a 0.5 Hz Change from Target Frequency

Provision and Instruction on Operating Reserve

- The amount of Operating Reserve required is determined by GSO in consideration of:
  - Demand levels
  - Generating Plant availability shortfalls and largest secured loss of generation
  - Loss of import or export via Interconnections
- GSO shall allocate OR to the various classes of Generating Plants

Data Requirements

- Operating Reserves related data required by GSO for operational purposes:
  - Frequency change data Primary Response characteristics
  - Frequency change data Secondary Response characteristics
  - Governor droop and deadband characteristics
  - CDGU control options for maximum, normal and minimum droop (% of delta Freq)
- Generators shall register this data with the GO and GSO under PC and verified under OC10

Data Requirements (cont)

- Response capability data required for Demand Control are:
  - Blocks of Demand available for disconnection at specific frequencies
  - Initiation System Frequency or Voltage conditions for disconnection
  - Time duration of Frequency and Voltage below trip setting
  - Time delay from trip initiation to disconnection

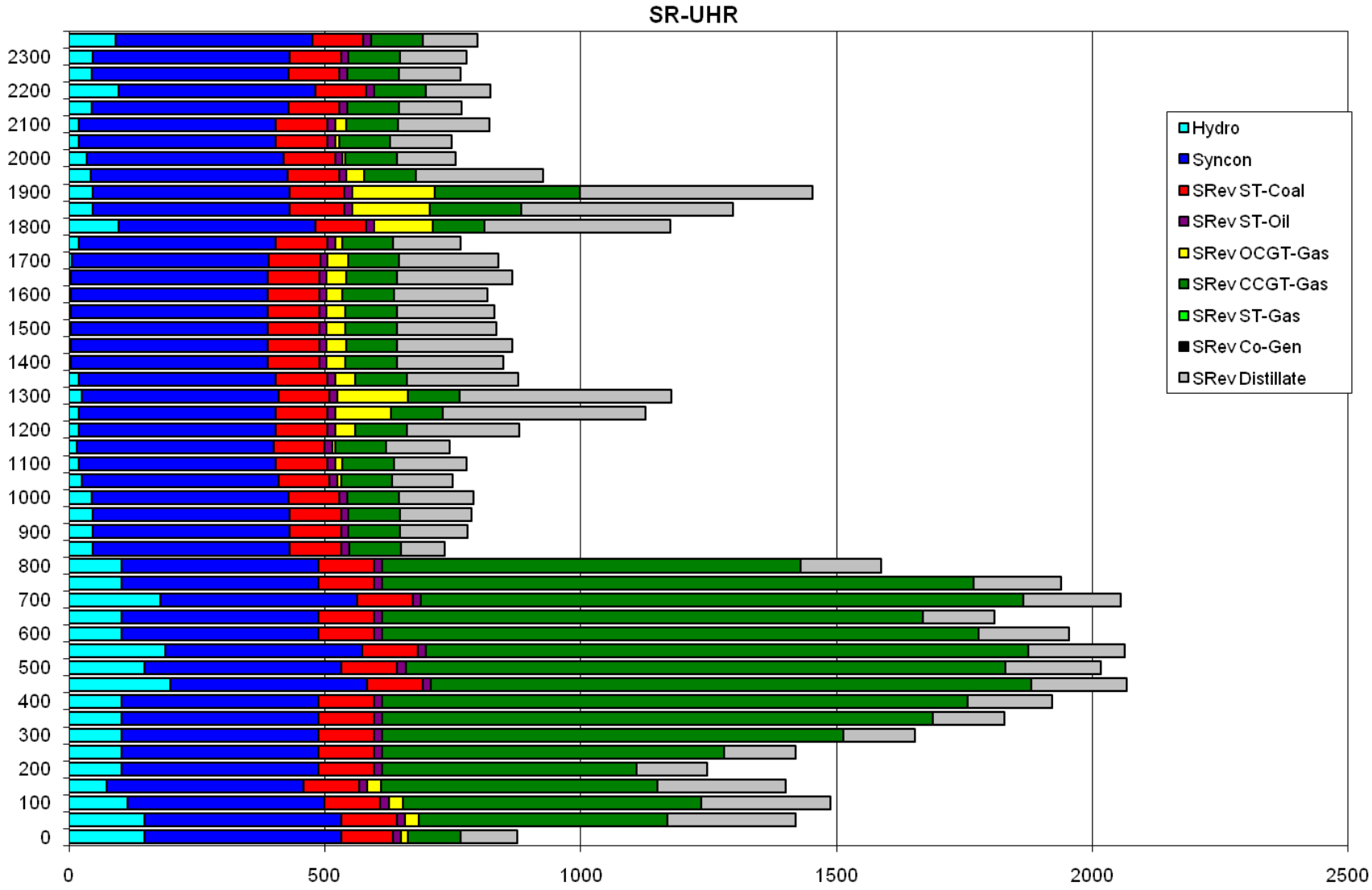
Weekly Operational Plan

- Includes an indication of the level of Spinning Reserve required beginning with the Schedule Day commencing during the subsequent Monday
- Prepare Weekly Operational Plan from 0000hrs on Sat to 2400hrs on a subsequent Mon issue by exception to each Generator when necessary
- In respect of all CDGUs and Demand Control agreeable participatory parties indicative requirement of Spinning and Non-spinning Reserves

Operating Reserve from Interconnected Systems

- Interconnected Party use of OR shall be recorded by GSO at the following day, with Provision and receipt managed by Single Buyer
- GSO shall determine in accordance to Interconnection Agreement, and communicated to the Single Buyer, when the use of the interconnector is necessary to restore the OR
- GSO will take necessary action to assist and restore the OR when an Interconnected Party requires its use to meet a sudden failure or shortage on its system, as if the loss of reserve is of its own

Example Daily Planned SR



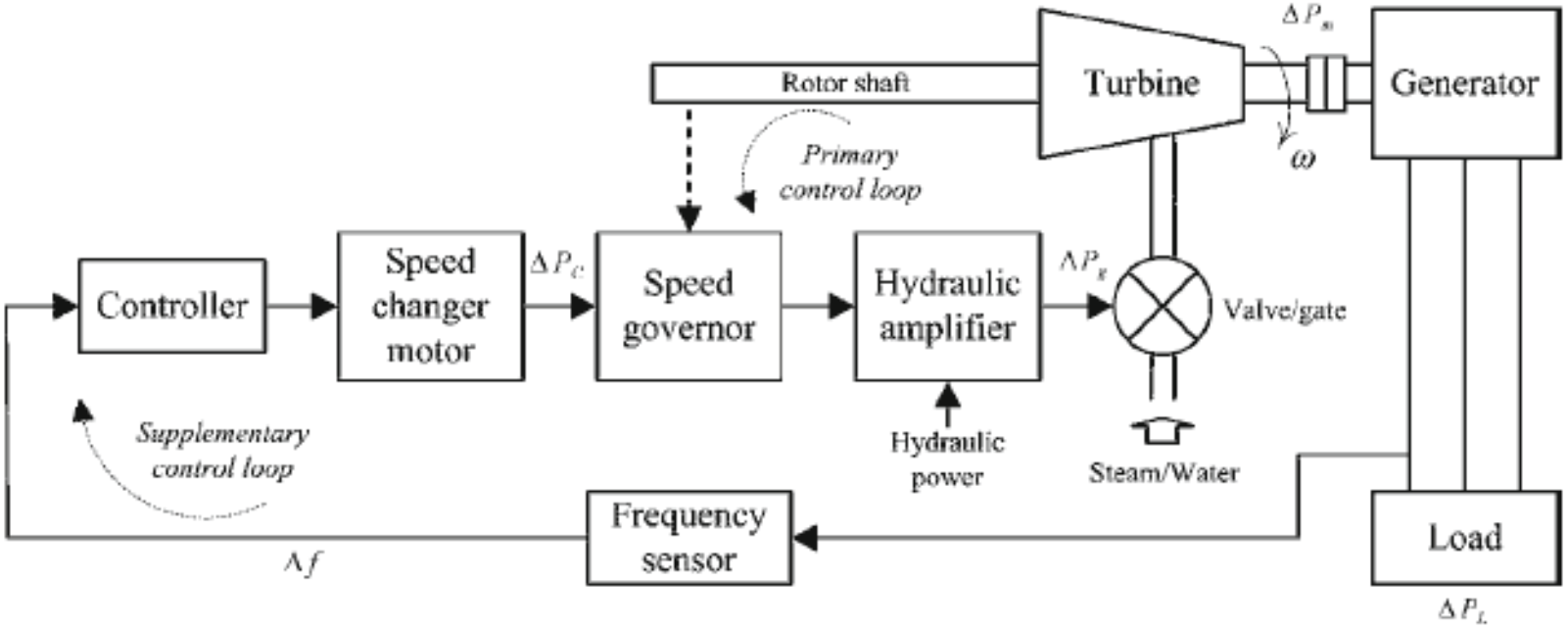
THANK YOU

KeTTHA
KEMENTERIAN TENAGA, TEKNOLOGI HIJAU DAN AIR

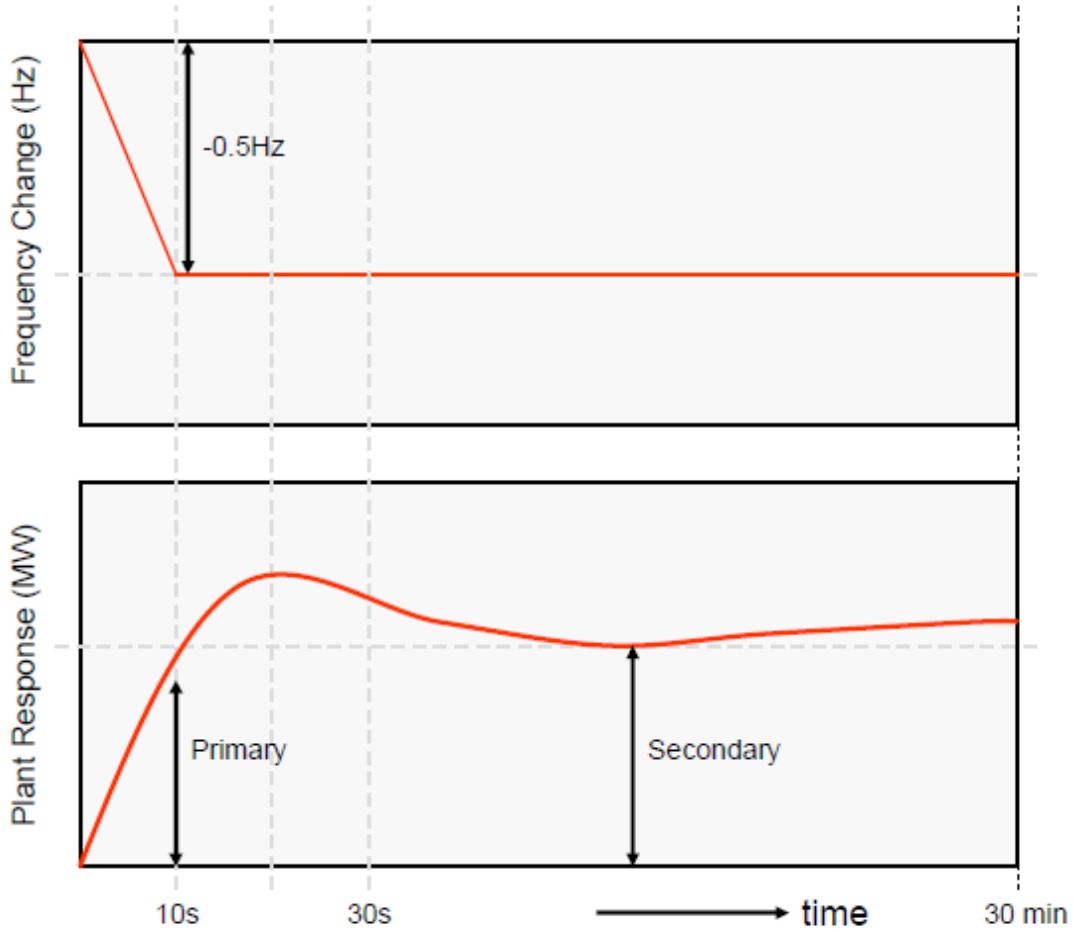
Suruhanjaya Tenaga

The Malaysian Grid Code Awareness Programme Funded by Akaun Amanah Industri Bekalan Elektrik (AAIBE)

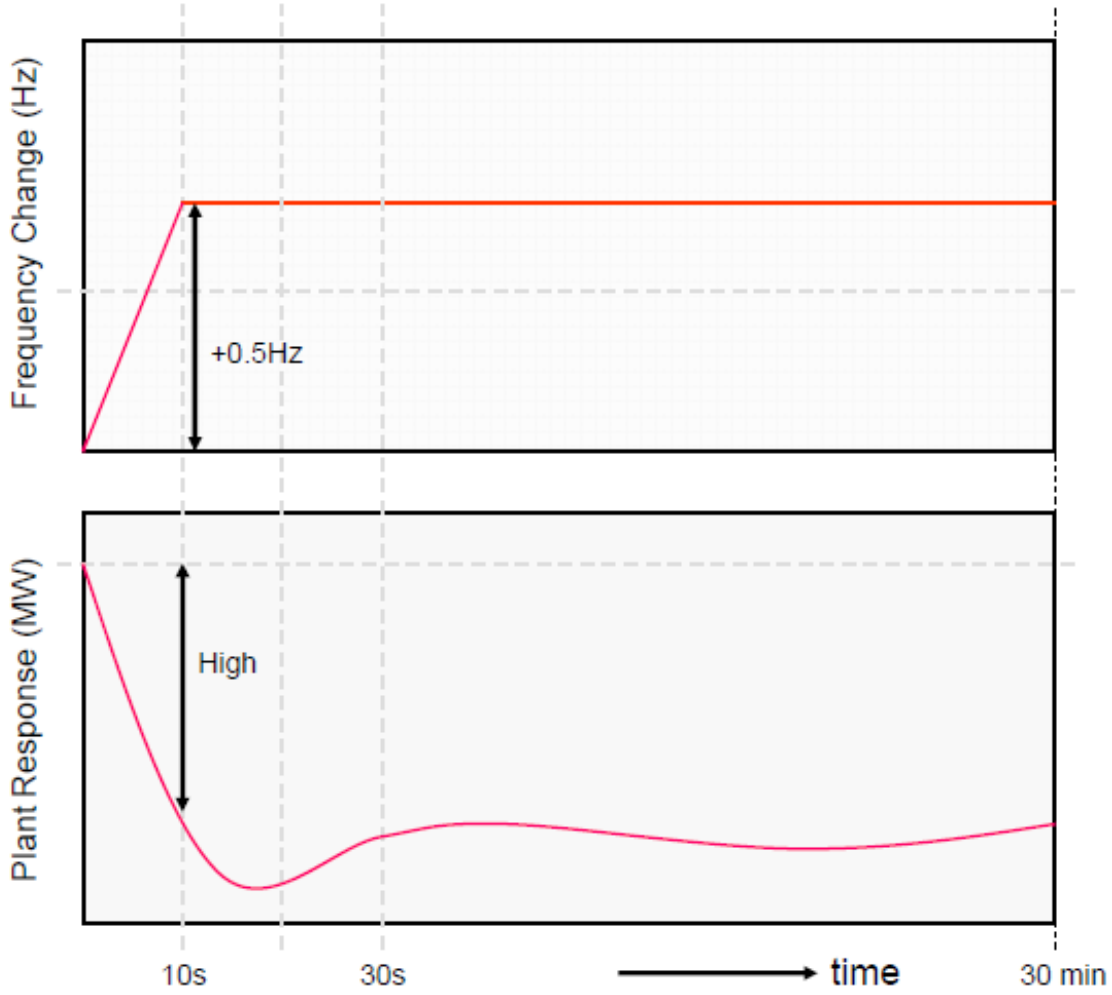
Basic Frequency Control Loop



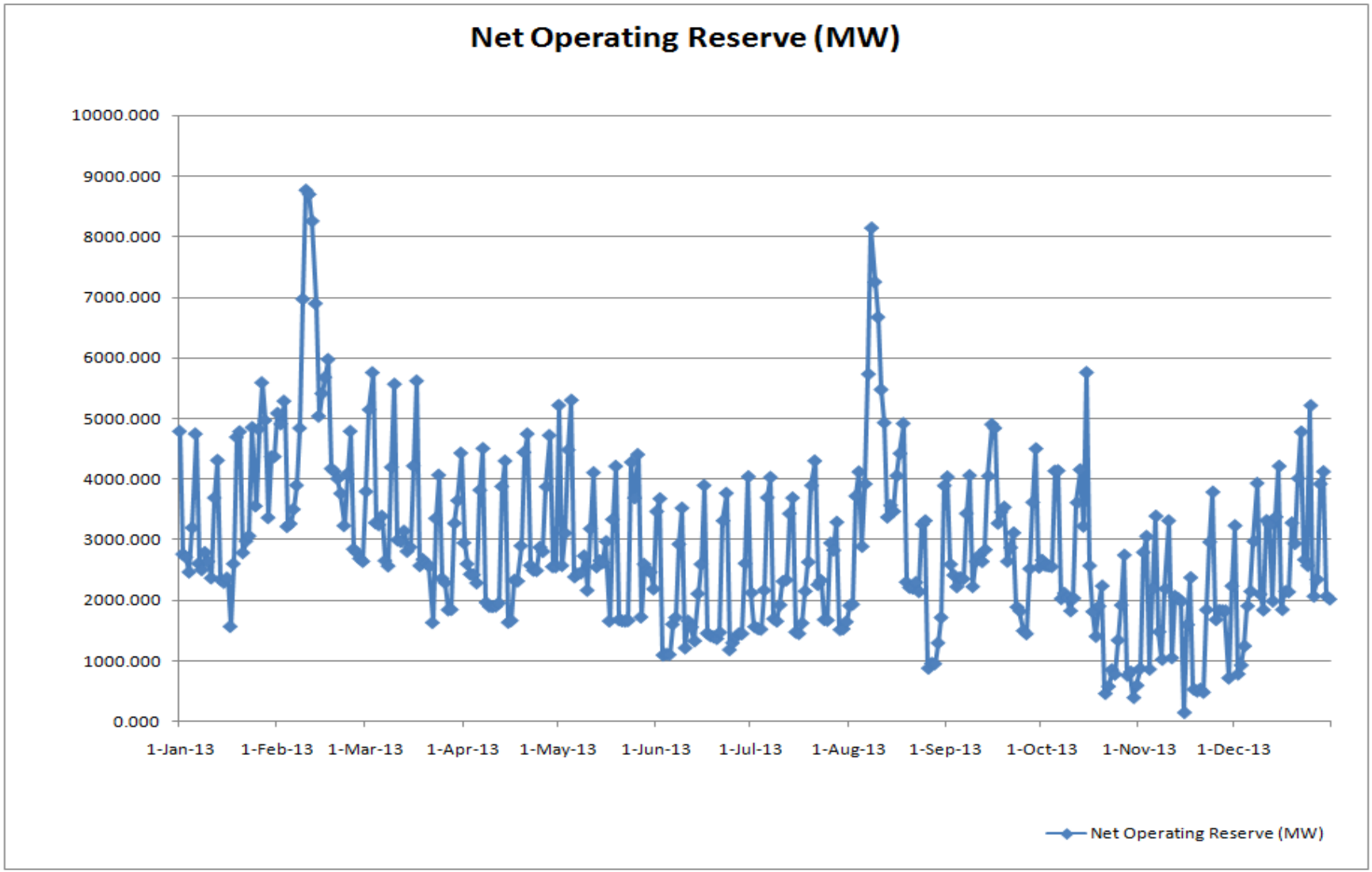
Interpretation of Primary and Secondary Response Values



Interpretation of High Frequency Response Values



TNB Operating Reserves 2013



TNB Operating Reserves 2013