Operating Codes

By :

NG BON LEONG

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Sabah dan Labuan Grid Code Awareness Programme Funded by
Akaun Amanah Industri Bekalan Elektrik (AAIBE)

Objectives:

At the end of the presentation, participants should have:

- an understanding what it takes to operate a grid system safely and reliably
- an awareness of the contents and the purposes of the 11 sections of the Operating Codes

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Contents of the presentation

1. Glossary and definition of some to the terms that appear in the Operating Codes
2. Some basic fundamental principle of power system
3. Explain each of the Operating Codes

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Glossary and Definition

Glossary and Definitions

Power System

Any Licensed power system in Sabah or Labuan, as the context requires. This includes;

- each Rural Network and its associated Power Stations; and/or
- the interconnected Networks consisting of the interconnected Transmission Networks and DNO and IDNO Distribution Networks and the Power Stations connected to these Networks.

Distribution Network

Apparatus operated by SESB or an IDNO operating at a nominal phase voltages of 33 kV or below synchronously connected to the interconnected Power System and including the associated protection systems and Plant.

Rural Network

Any Network situated in Sabah or Labuan that is Licensed, and is **not capable** of being synchronously connected to the Transmission Network in Sabah and Labuan.

User Network

A User Network or User installation including the HV Apparatus at the Connection Point owned by that User.

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Glossary and Definitions

Grid System Operator or (GSO)
The person in SESB responsible for the overall coordination of the operation, maintenance and control of the interconnected Power System amongst all Users. The GSO is also responsible for generation Dispatch and monitoring and control of this Power System to ensure that the Power System is operated, at all times, reliably, securely, safely and economically.

Load Dispatch Centre or LDC
A dispatch centre and/or control centre responsible for the issuing of Dispatch instructions to CDGUs and coordinating the Transmission Network or a Rural Network operations and Load, including safety coordination, as the context requires.

Dispatcher
That person currently on duty and authorised by the GSO or an RSO to issue Dispatch instructions to Power Producers for the operation of CDGUs.

Single Buyer
The department in SESB responsible for initiating the process for the procurement of new generation and the drafting of new PPAs for signing between the relevant parties and monitoring of existing PPAs. *The Single Buyer also has the right to monitor the scheduling, dispatch and operational planning by the GSO to ensure the equitable operation of the PPAs.*

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Glossary and Definitions

Transmission Network Operator (TNO)

A unit within SESB responsible for the operation and maintenance of a Transmission Network and its associated Plant and Apparatus for the purpose of providing transmission services, including access to the Transmission Network.

Network Controller

the manager or senior professional engineer responsible for the Network *Operator's control centre* who is responsible for the site safety of that part of the Network where the User has its Connection Point

Network Operator

The TNO and/or DNO and/or RNO and/or IDNO as the context requires.

Network Planner

Network Planner undertakes the planning and development of their Networks, which also takes due account of the network development plans required to meet future generation requirements

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Glossary and Definitions

Distribution Network Operator or DNO

SESB or an IDNO responsible for the operation, maintenance and planning of a Distribution Network synchronously connected to the interconnected Power System for the purpose of providing distribution services to other Users.

Independent Distribution Network Operator or IDNO

A business entity independent of SESB that is Licensed to operate a Network for the purpose of supplying electricity to Consumers.

Rural Network Operator (RNO)

A person responsible for the operation, maintenance and planning of a Rural Network including the associated Plant and Apparatus required for the purpose of providing distribution services to other Users or supplying Consumers.

Rural System Operator (RSO)

The person in SESB responsible for the overall coordination of the operation, maintenance and control of a rural Power System amongst all Users. The rural system operator is also responsible for generation Dispatch and monitoring and control of this rural Power System to ensure that the rural Power System is operated, at all times, reliably, securely, safely and economically.

***Rural Network --** Any Network situated in Sabah or Labuan that is Licensed, and is **not capable** of being synchronously connected to the Transmission Network in Sabah and Labuan.*

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Glossary and Definitions

Power Producer
Any entity which has a generation Licence, including SESB, IPPs and Self-generators which owns or operates Generating Units which connect through a User installation or directly to a Power System in Sabah and Labuan

Independent Power Producer or IPP
A business entity independent of SESB connected to the Power System which produces electricity from its Generating Units and sells the majority of the output to the Single Buyer.

User
Any person making use of a Power System in Sabah or Labuan, as more particularly identified in each section of the Grid Code. In certain cases this term means any person to whom the Grid Code applies.

Associated User
When reference is made to a User who does not own the Metering Installation at a Custody Transfer Point but has a contractual interest in the test results or data flowing from the Metering Installation, then within the Metering Code the term associated user is used to differentiate them from the User who owns the metering equipment. For the avoidance of doubt, the associated user includes a Consumer who has such an interest.

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Glossary and Definitions

Apparatus

All electrical equipment in which electrical conductors are used, supported or which they form a part. Where reference is restricted only to HV apparatus this will be indicated in the specific text as “HV Apparatus”.

Plant

Fixed and movable equipment used in the generation and/or supply and/or transmission and/or distribution of electricity other than Apparatus.

For the avoidance of doubt, equipment may be considered to be plant even though it contains LV conductors, that provide electrical power for that plant item.

Centrally Dispatched Generating Unit or CDGU

A Generating Unit subject to Dispatch by the GSO

Glossary and Definitions

Approved Person
A person appointed in writing who is suitably qualified and experienced for the duties he is required to perform in accordance with the requirements of Electricity Sector Safety Laws and Prudent Utility Practice.

Interconnected Party
Any person located outside Sabah and Labuan, which owns and operates an Interconnector.

Glossary terms in MGC 2010

The party who is the signatory of an Interconnection Agreement

Interconnection
The physical connection (consisting of Plant and Apparatus) connecting the Transmission System to an External System.

Interconnection Agreement
An agreement made between the Single Buyer and an Externally Interconnected Party relating to an External Interconnection.

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Some Fundamental Principles of Power System

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Mission of GSO

Safe, reliable and economic operations

- The function of an electric power system is to provide electricity to its customers efficiently and with a reasonable assurance of continuity and quality.
- Continuity and quality of electricity depend on the reliability of the power system

Reliability = Adequacy + Security

Adequacy

- Sufficient capacity (generation as well as Plants and Apparatus of Network) to cater for demand & contingency
- **Redundancy**

Security

- Ability to withstand disturbance
- **Stability**

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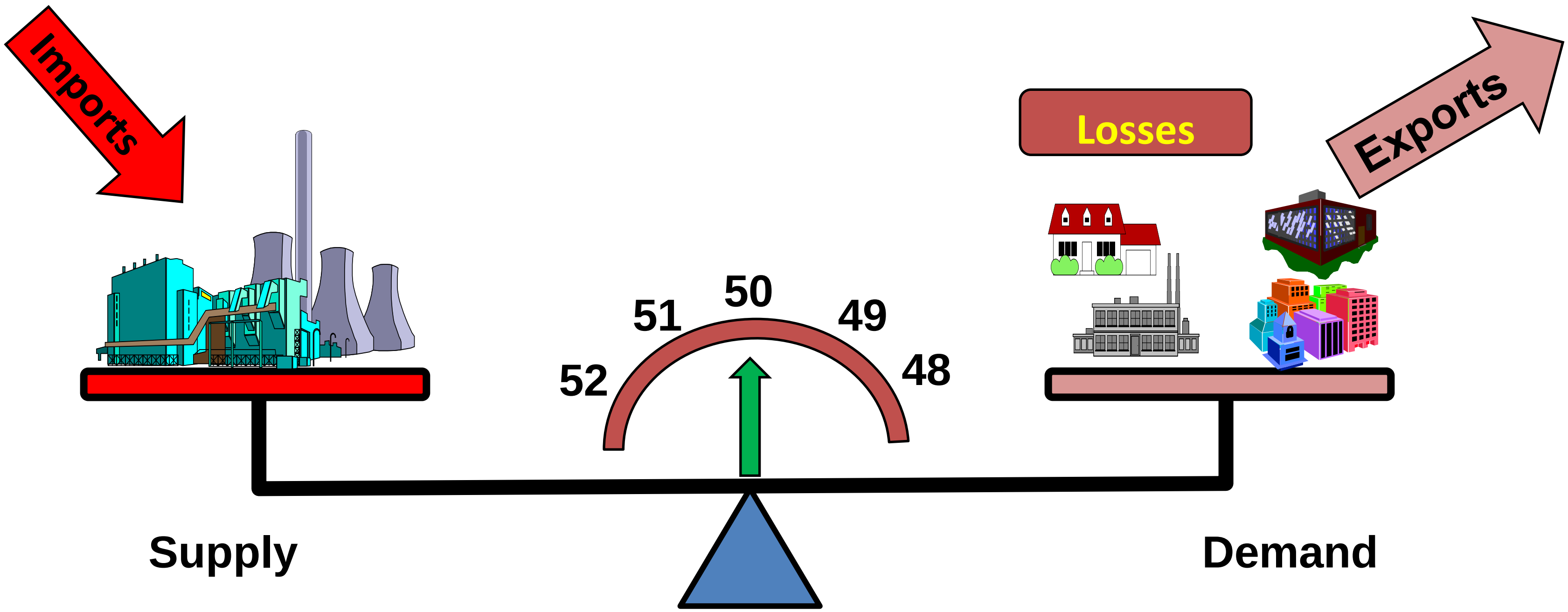
Keeping the System Frequency "Constant"

Basic Reliability Rules

- Supply & demand must be in balance



Must address both Adequacy and Stability Issues

Three Stability Issues

Power System Stability

- **Ability to remain in operating equilibrium after subjecting to a disturbance**

Frequency Stability

- Active Power Balance

Voltage Stability

- Reactive power balance

Supply/demand balance (incl. losses)

Angle Stability

- Torque balance of synchronous machines

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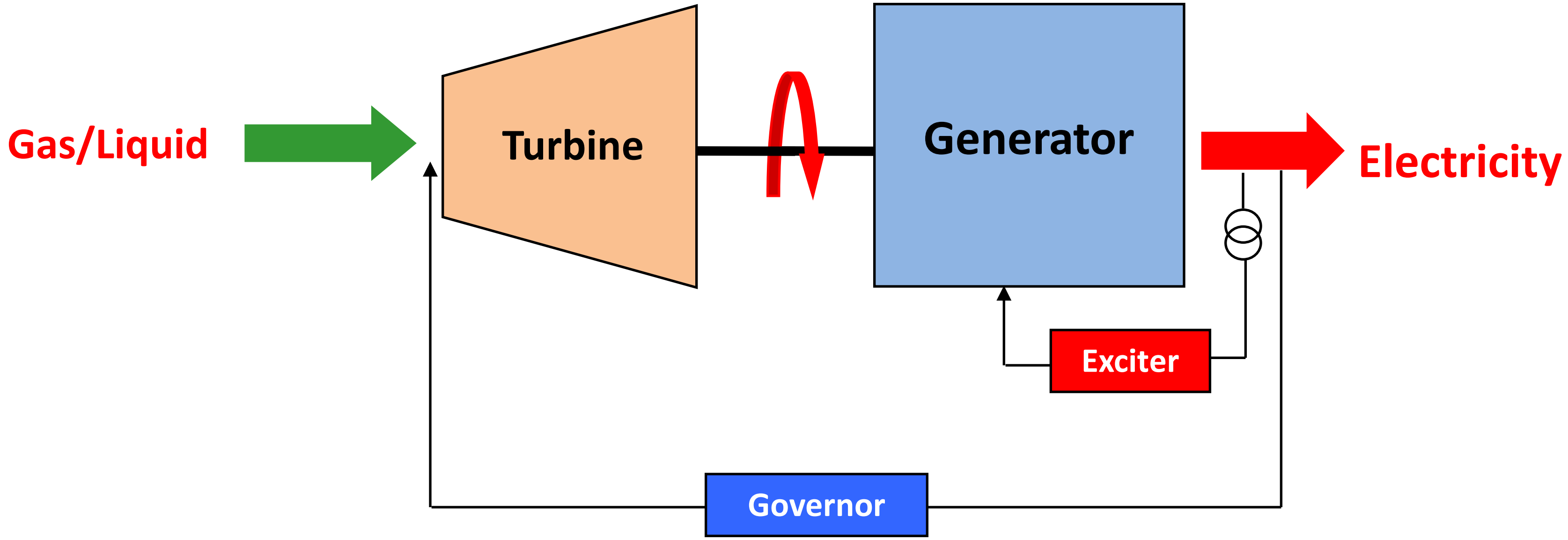
Voltage and Frequency Control



Exciter of a generator controls the voltage of a generator

Governor of the turbine controls the power output of the same generator

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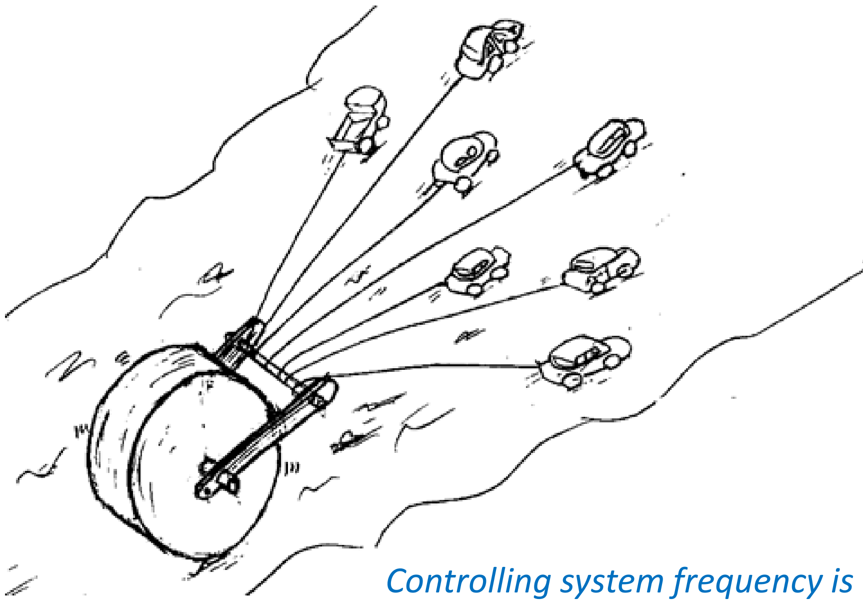
Frequency As Real Power (MW) Balance Indicator

- Power generated must be equal to power consumed (+ losses)
- Frequency is **"the same"** at any part of network
- If there's a sudden loss of generation, energy imbalance is made up from kinetic energy of all rotating generators
- The speed (frequency) drops triggering all turbine governors to increase generation automatically (feedback control)
- If frequency drops too much, automatic load shedding is activated
- Generation deficit => frequency drops, generation surplus => frequency increases



From NGC

Controlling system frequency is not an easy task.
It's like pulling a big wheel up a bumpy hill and trying to keep the speed at 50km/hr

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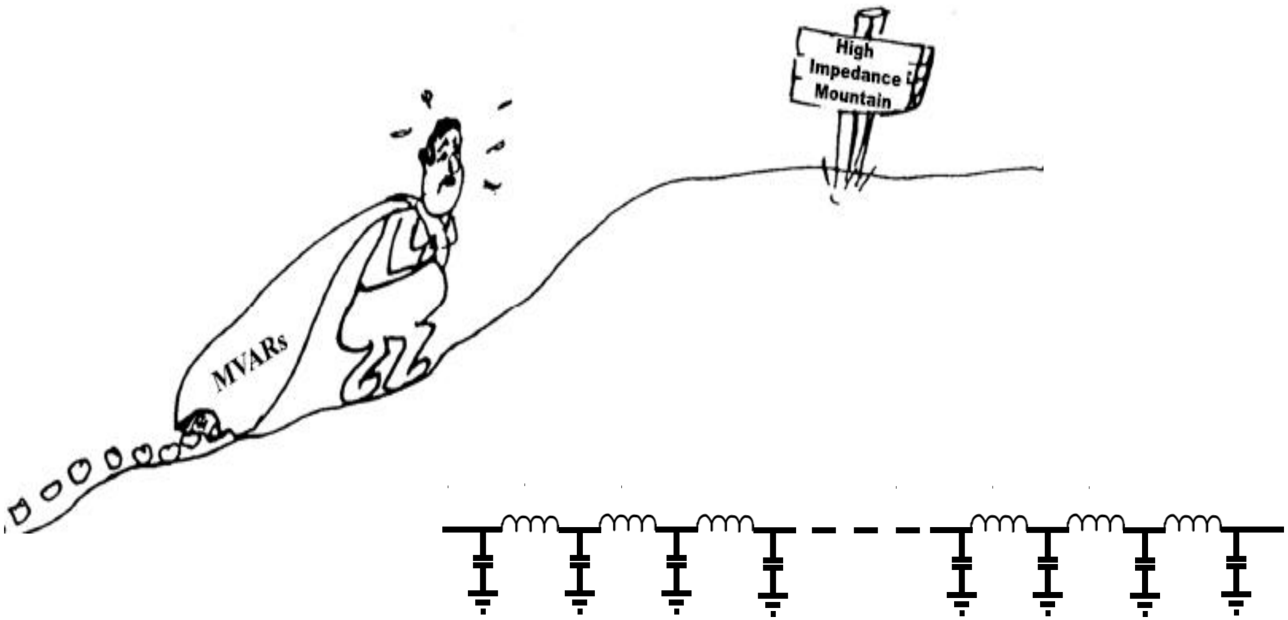
Challenges of Voltage Control

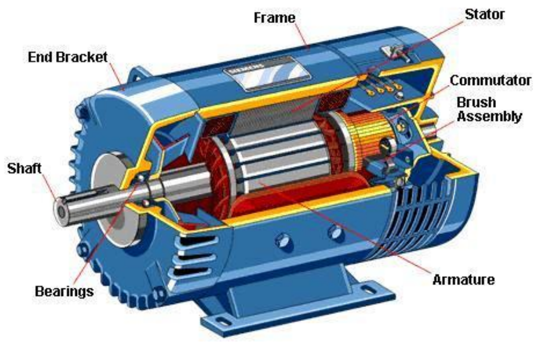


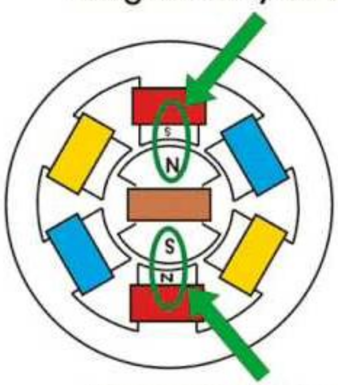
Challenges:

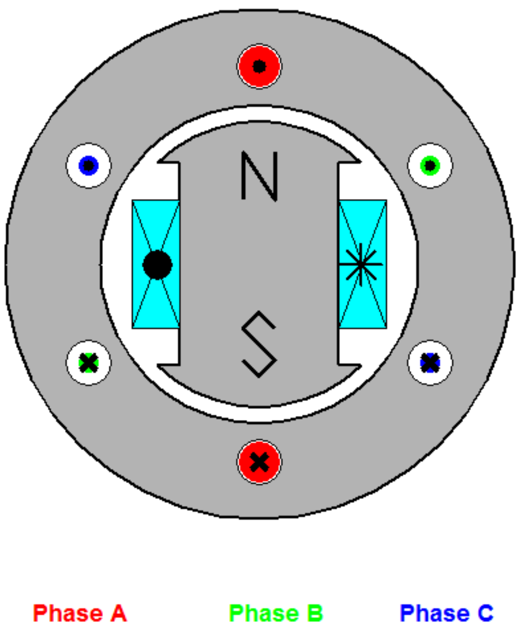
- Reactive power cannot be transmitted over long distances, voltage control has to be effected by using special devices dispersed throughout the system where they are required.
- The proper selection and coordination of equipment for controlling reactive power and thus voltage are very important for the security of system operations.

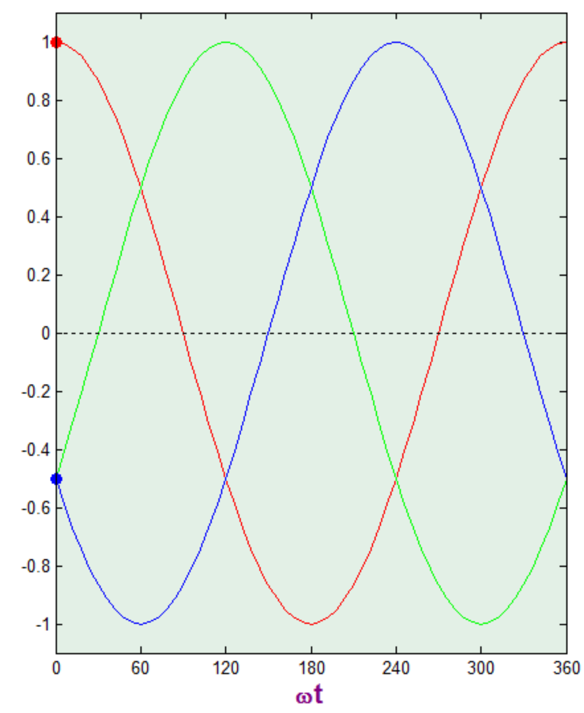
Power Transfer Via Electromagnetic Coupling

- Air exist between rotor and stator of either a generator or a motor
- What is the medium of power transfer across rotor and stator?
- The medium of power transfer from rotor to stator in the case of a generator or stator to rotor of a motor is electromagnetic field as shown in the diagrams below



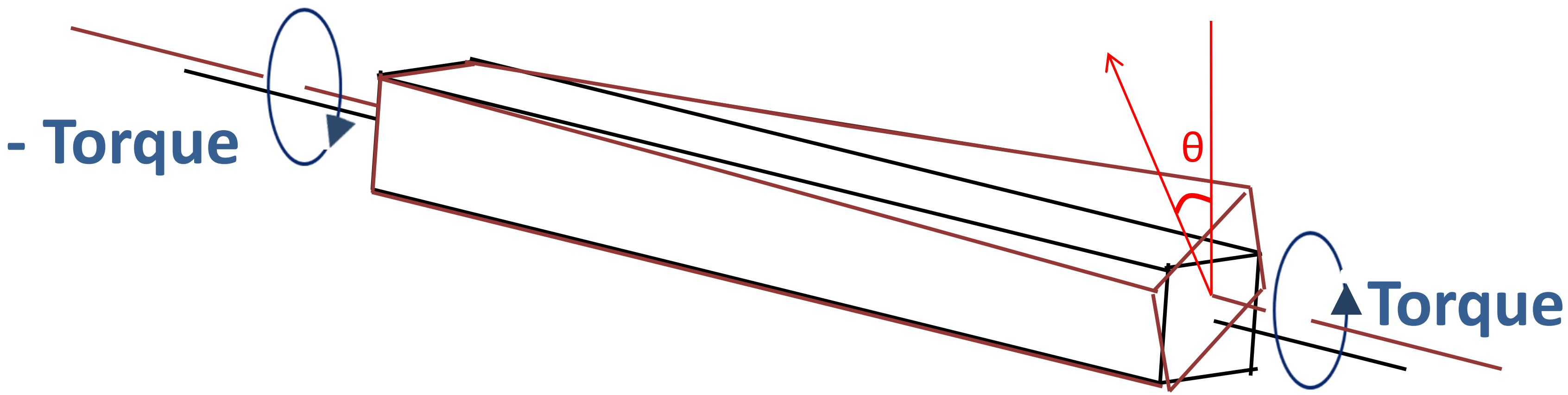






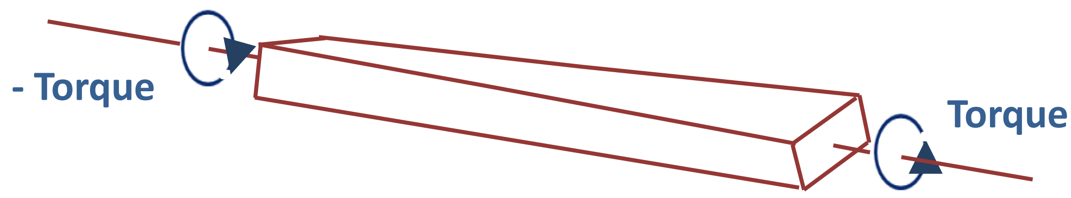
The Bigger The Torque The Bigger The Angle

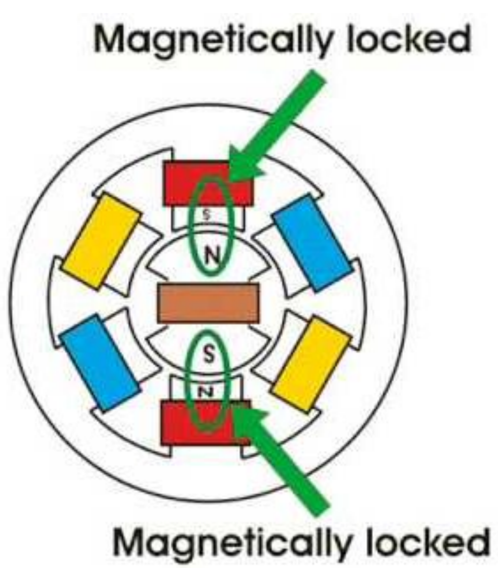
Transferring torque across a piece of wood



- The larger the torque the larger the angle difference
- For a piece of wood of similar cross section area but 3 times longer, the same torque applied will cause a larger angle difference between the ends
- For a thinner (smaller cross sectional area) piece of wood, the same torque will cause larger angle difference between the ends

Useful Work & Medium of Transfer of Energy





Motor

Example 1
The useful work is the transfer of torque from one end to the other end.

Example 2
The useful work in a motor is the conversion of electrical energy from the stator to the kinetic energy of the rotating shaft of the rotor.

In Example 1 the medium of transfer of torque is the piece of wood and Example 2 the medium of transfer of transfer is electromagnetic field created by the stator windings

The useful work is the kinetic energy of the rotor. The electromagnetic field provides the medium of transfer as well as the conversion of electrical energy to mechanical energy

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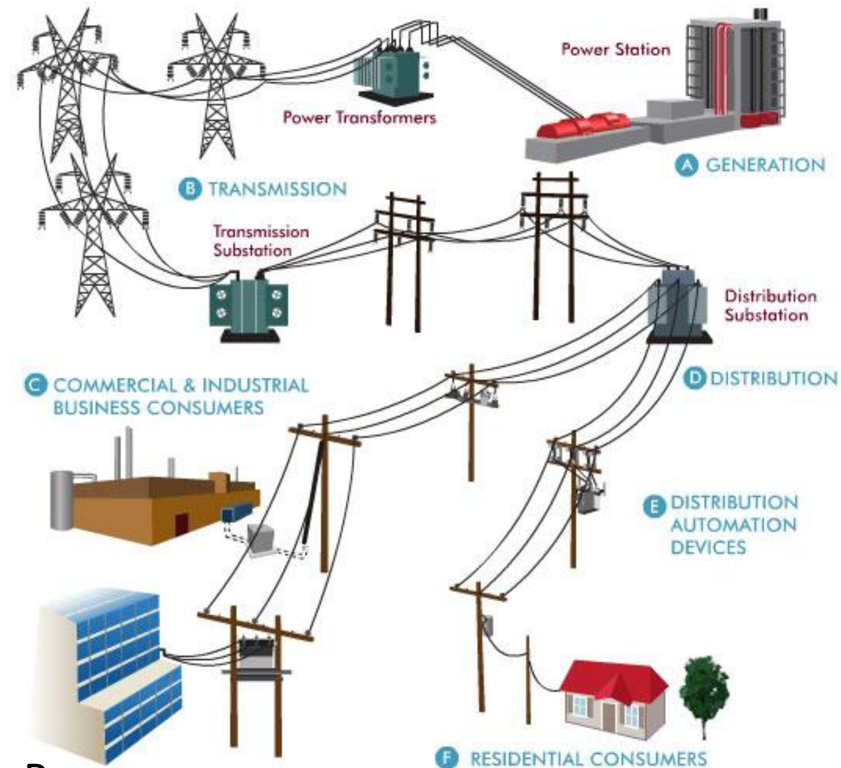
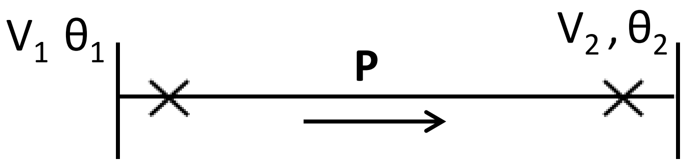
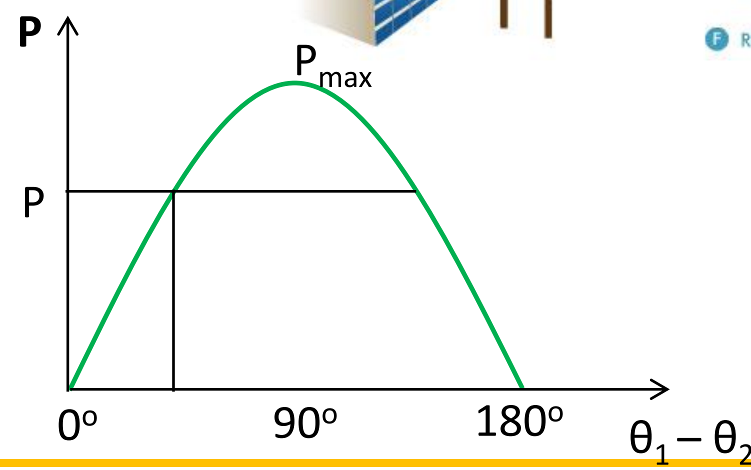
Voltage Angles of a Power System

- Similarly when electrical power flows across the power network, the more the power flows, the larger the voltage angle difference at the load end
- The longer the distance between the generation and load the larger voltage angle difference.
- The power transfer across a conductor is governed by the formula:





$$P = \frac{V_1 \times V_2 \times \sin(\theta_1 - \theta_2)}{X_{1-2}}$$



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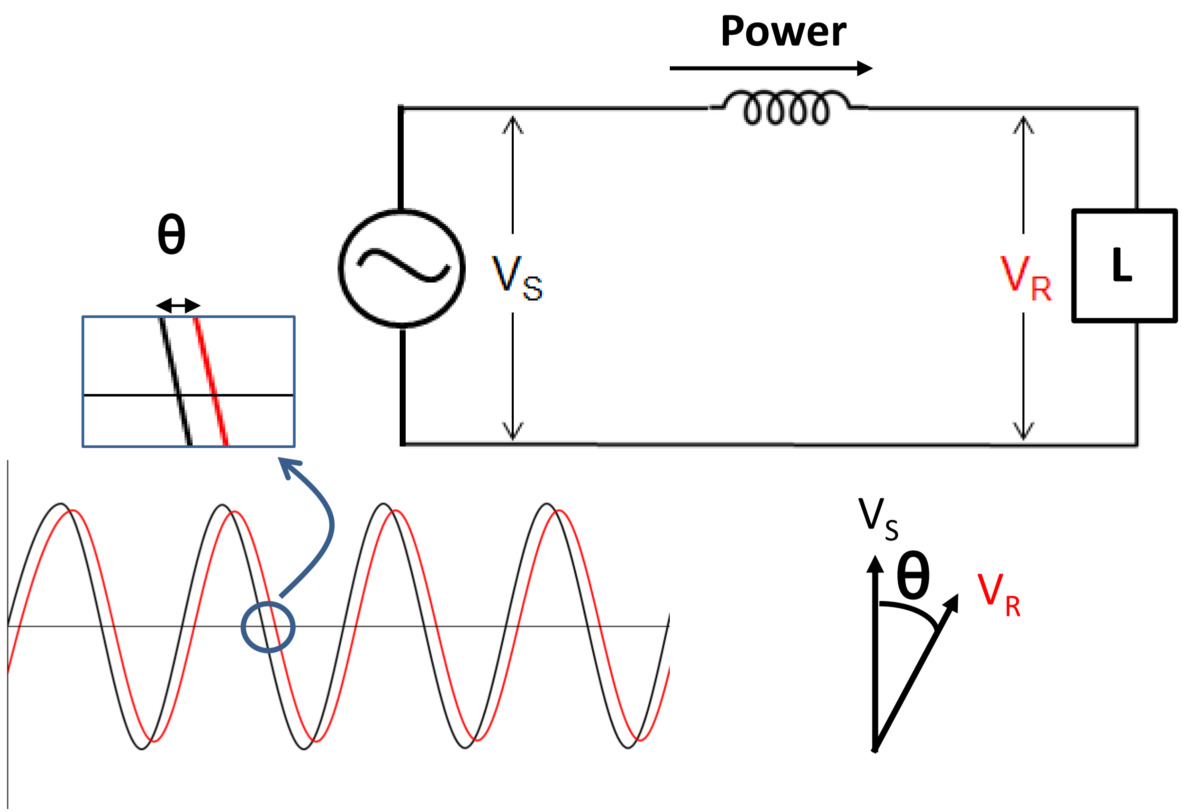
Another View of Voltage Angles

Voltage angle at Receiving End Lags behind voltage angle at Source End



$$P_S = \frac{V_S \times V_R}{X_L} \sin\theta$$

The larger the power flow or the bigger the reactance the larger the angle difference between them

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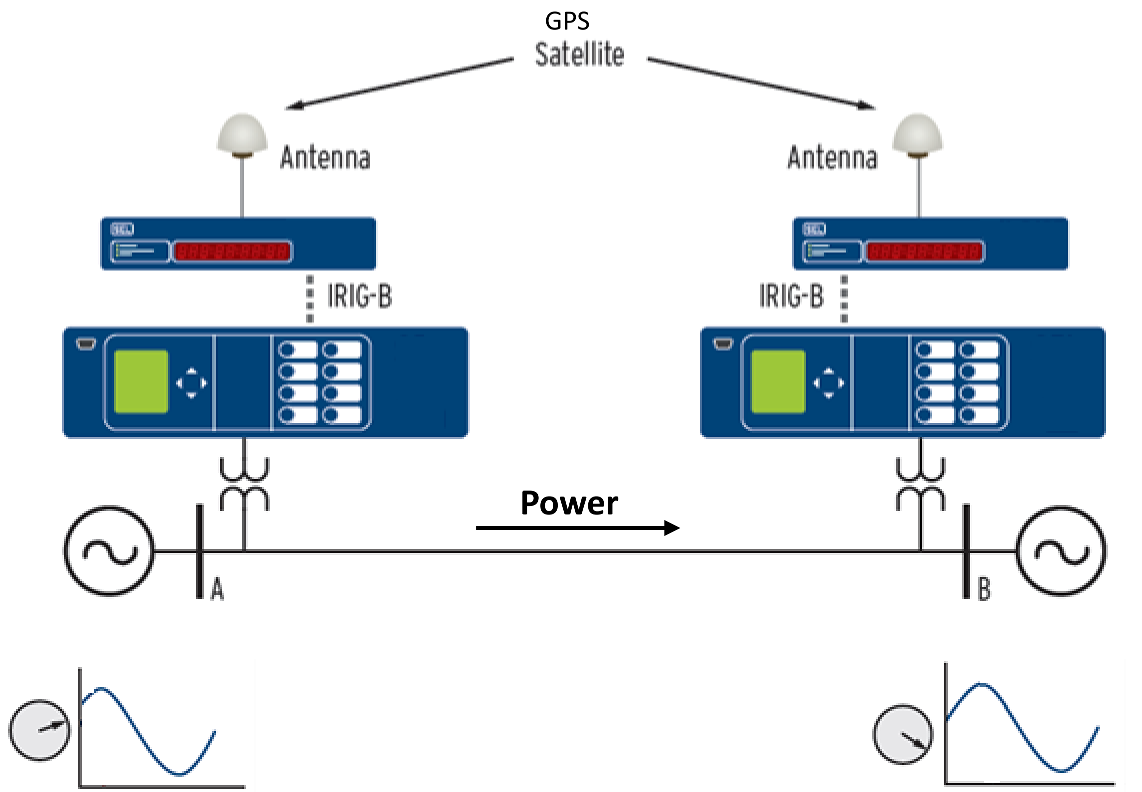
Using Phasor Measurement Units to Measure Voltage Angle



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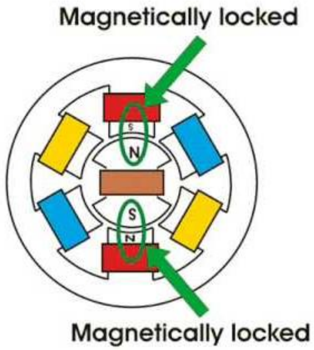
System Frequency

- System frequency is normally the "same" throughout the whole network of the grid system when the system is not "disturbed"

- Whenever there is a disturbance to the system due to generator tripping or fault, frequency at various parts of the system drift apart slightly. And after some time will be the "same" again.

- It is very important that the generators in the grid system do not drift too far apart otherwise they will run out of "syn". Generators that run out of "syn" will trip and cause the system to collapse.

- It is the electromagnetic coupling that "locked" or keep the generators running synchronously with one another.



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Three System Stability Issues

Power System Stability

- **Ability to remain in operating equilibrium after subjecting to a disturbance**

Frequency Stability

- Active Power Balance

Use generators in the system to control this

Voltage Stability

- Reactive power balance

Angle Stability

- Torque balance of synchronous machines

These two are more difficult to control. Depending on:

- voltages at various transmission nodes
- distance of demand from supply
- quantum of power transfer
- network topography

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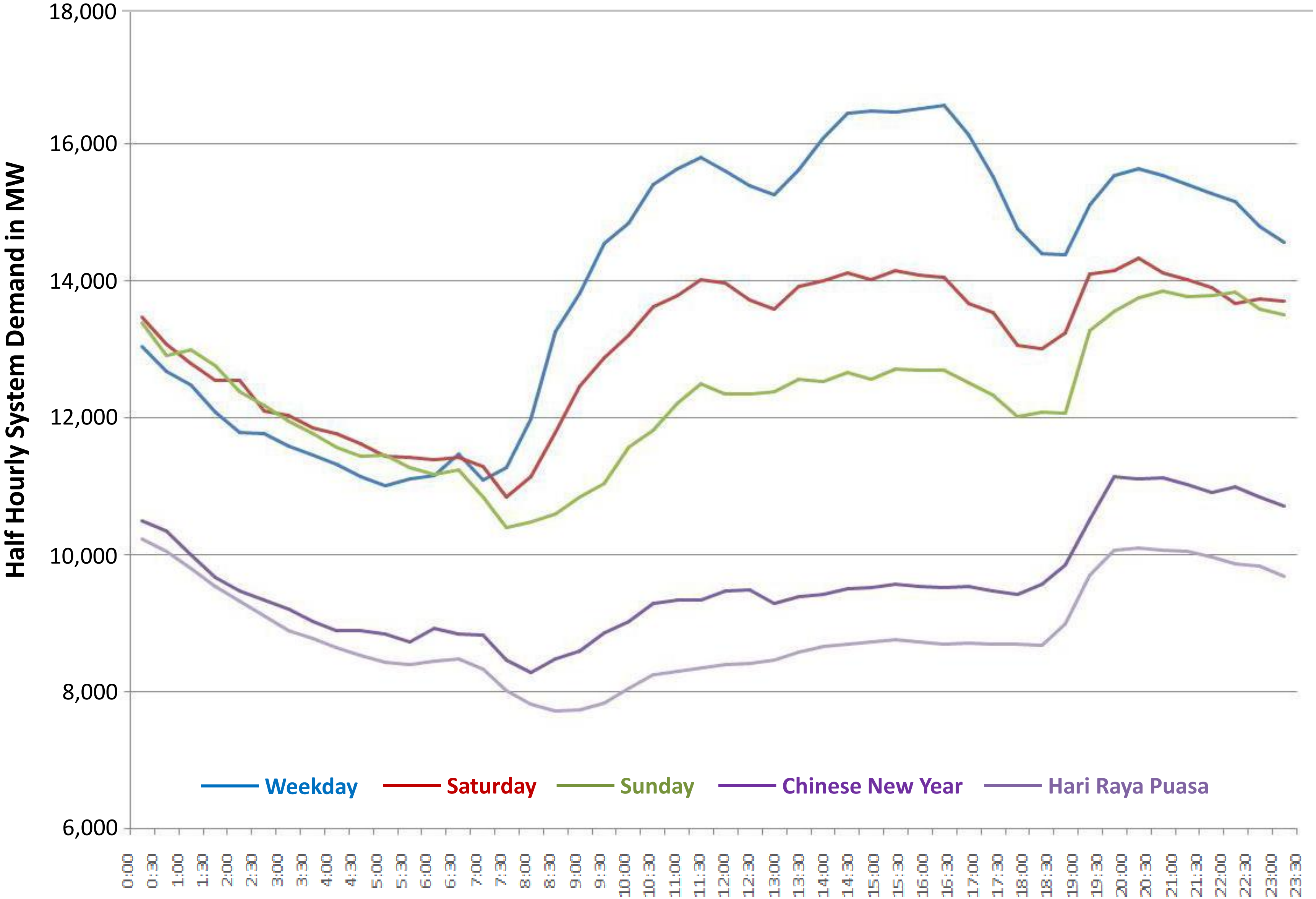
Typical Daily Load Curves of Peninsular Malaysia Grid



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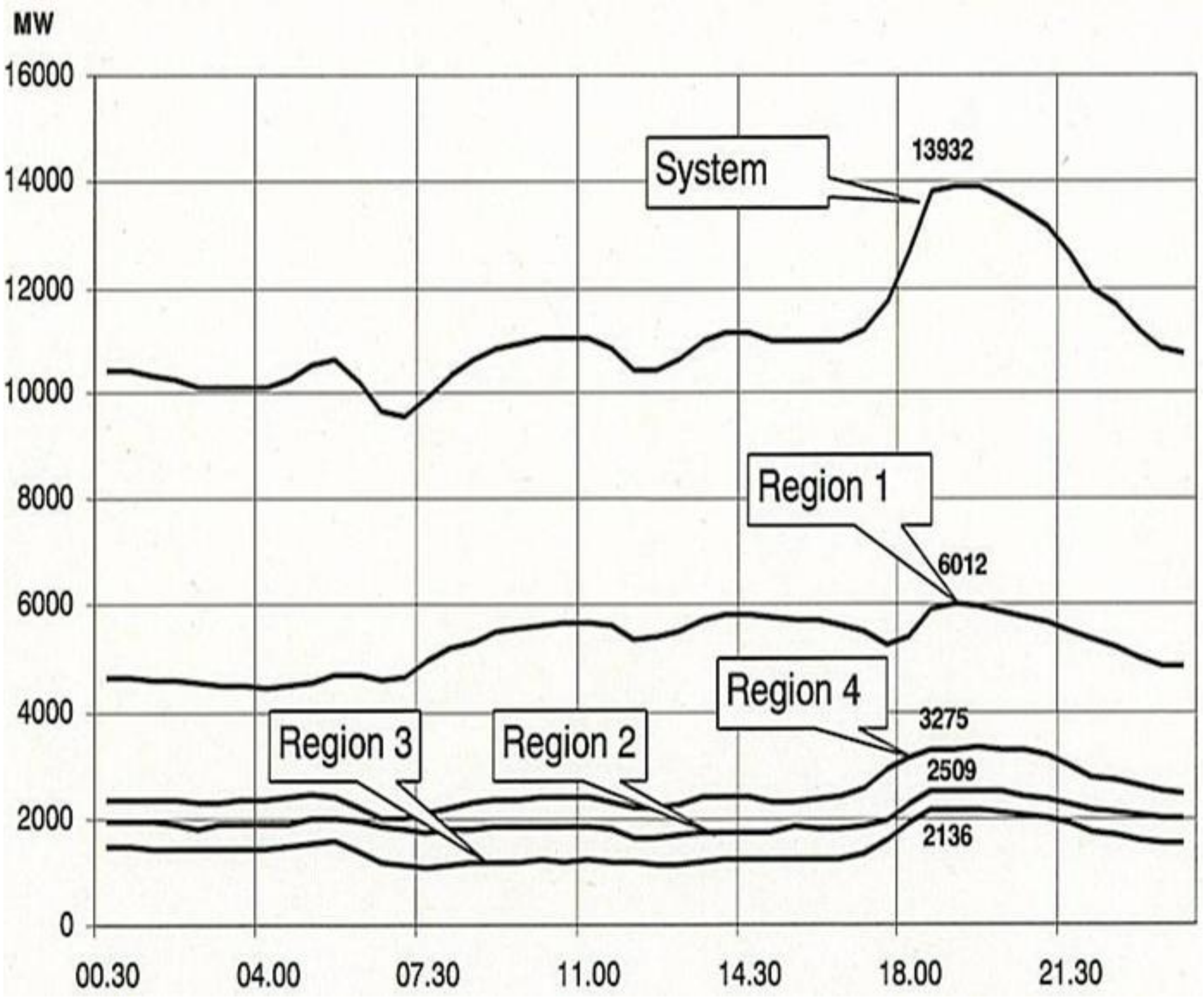
Weekday Load Curve for Java Island



Questions

1. What is system frequency and how to control it?
2. Why need to forecast demand?
3. What are the factors that affect demand?
4. How accurate can one forecast system demand?
5. What if it is wrong?
6. Why need to forecast Active Power?
7. Why need to forecast Reactive Power?
8. Why need to forecast Active Energy?
9. Why no forecast for Reactive Energy?

Consideration for generating units:

1. Need time to start up and shutdown
2. Minimum stable operation load
3. Forbidden zones
4. Maximum allowable load
5. Maximum and minimum excitation
6. Lake level
7. Gas availability and gas pressure
8. Fuel supplies
9. Cost of generation

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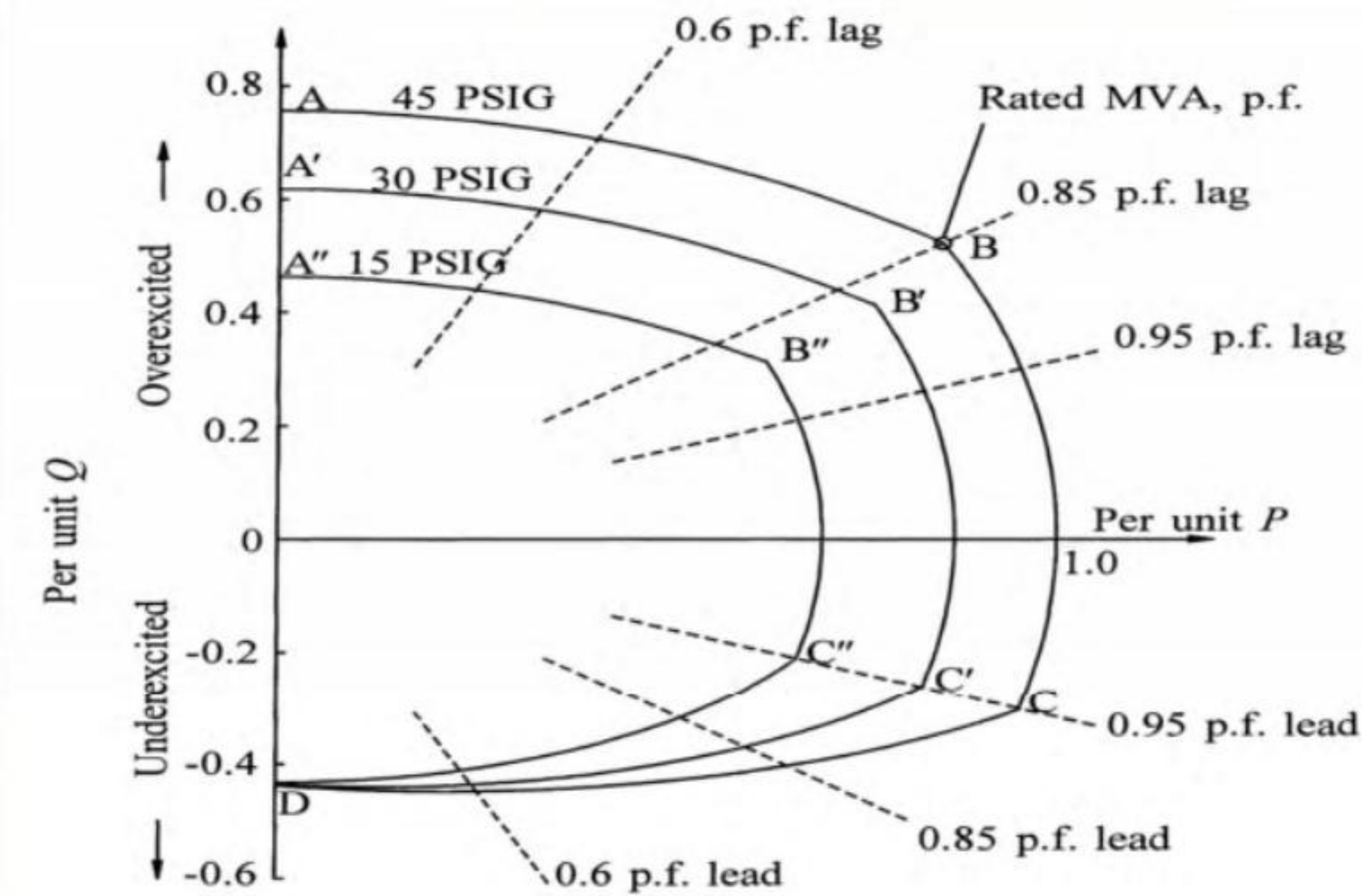
Generator Capability Curve



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OC1 Demand Forecast

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OC 1 DEMAND FORECASTING

OC1.1 Introduction

Demand forecasting to ensure that Generating Unit Scheduling and Dispatch will be matched to Demand.

Reliable

Energy forecasting to minimise cost of generation by:

- manage the take-or-pay gas contracts
- optimising use hydro-electricity reservoir usage and
- optimising *(fuel purchase)* cost of generation

Economic

Demand Forecast in:

- Operational Phase covers Short Term (up to 1 year ahead) to Near Term (up to 1 month ahead) to start of Control Phase
- Control Phase covers Near Term (up to 1 week ahead) to real time
- During real time, need to forecast up to 4 hours ahead

In the Code, there is demand forecast for "Post Control Phase" defined as "phase following real time operation": don't need to forecast!

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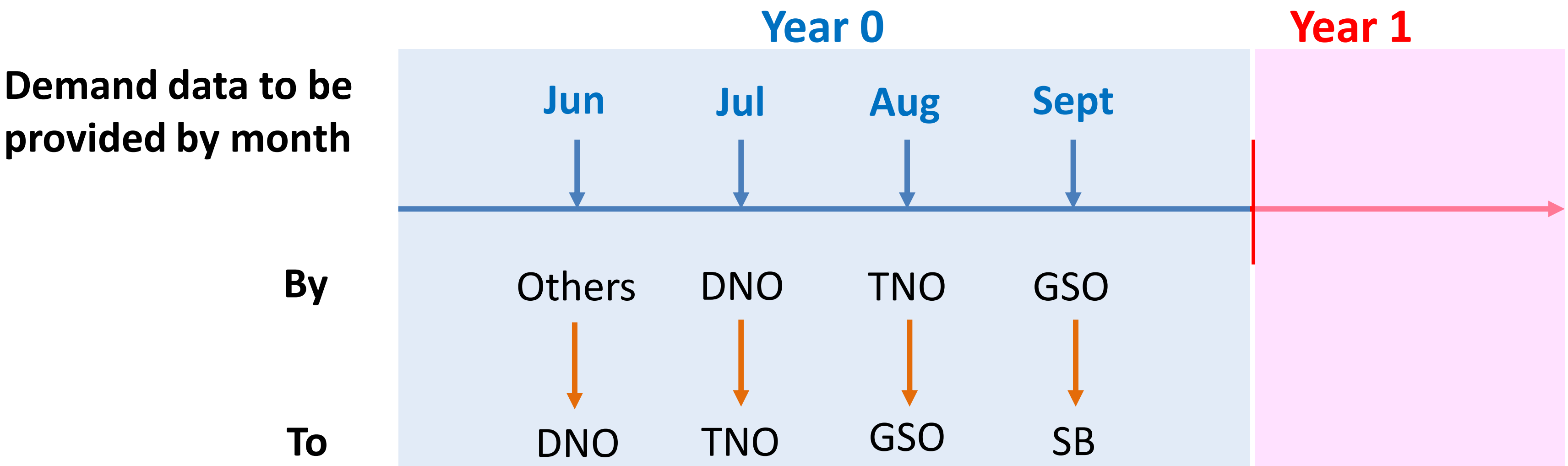
OC 1 DEMAND FORECASTING

OC1.4.2 Information Provider



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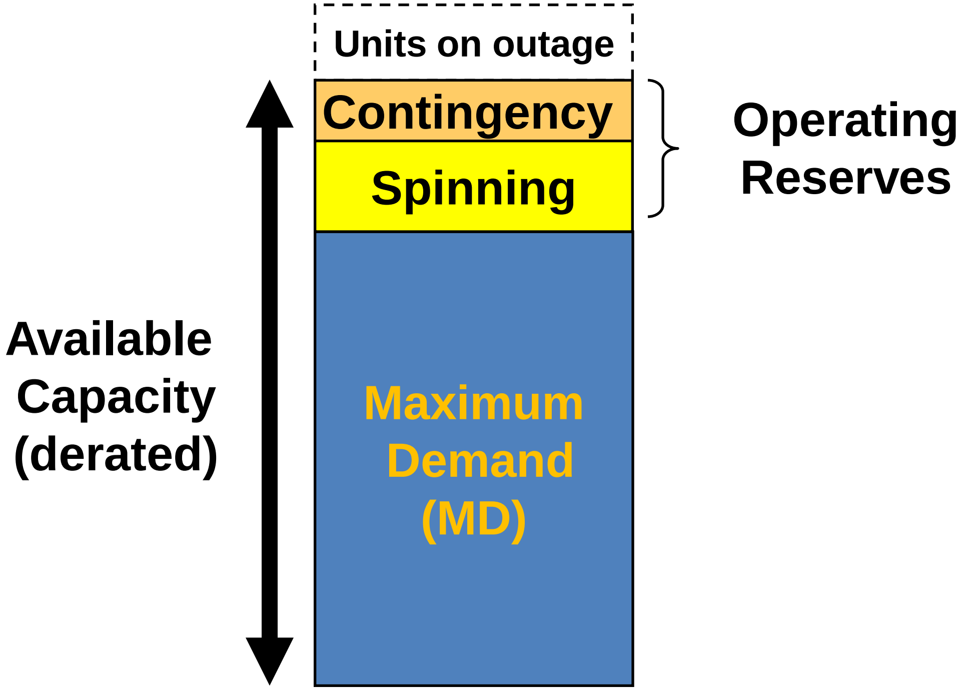
OC2 Operation Planning

OC2 OPERATIONAL PLANNING

Reliability = Adequacy + Security

Proper Operational Planning to ensure adequacy of generation as well as transmission Plant and Apparatus to satisfy demand – Outage Planning



OC 2.5 Grid Outage Committee – plan for coordinated outages of Generating Units and Network Equipment

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OC2 OPERATIONAL PLANNING

OC 2.6 Outage Planning Procedures For Power Producers With CDGU

OC 2.6.1 Near Term – up to 1 month ahead

3rd week of Month 0 – review the Indicative & Provisional Generator Maintenance Schedules and revise the Schedules where necessary

OC 2.6.2 Short Term – up to 1 Year ahead

End of August of Year 0 – Generators provide GSO with a Provisional Generator Maintenance Schedule which covers Year 1

GSO uses this to produce approved Annual Generation Plan for Year 1 by end of September of Year 0

OC 2.6.3 Medium Term – up to 5 Years ahead

End of March of Year 0 – Generators provide GSO with a Indicative Generator Maintenance Schedule which covers Year 1 up to Year 5

Long Term

A period covering from 5 years ahead to 10 years ahead.

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OC 2.7 Network Maintenance Schedule

Network Maintenance Schedule develops by Network Operator in consultation with GSO based on a *"Network Maintenance Criteria"* which has been submitted to EC for information

Network Maintenance Schedule contains:

a) Nature of maintenance to be carried out
b) Required duration of outage
c) A start outage date, time and outage duration

Important to preserve the reliability of Network as well as coordinate with Committed Generator Maintenance Schedules

By end of August of Year 0 Network Operator will provide GSO with Network Maintenance Schedule covers Year 1 on a daily basis

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OC3 Operating Reserve

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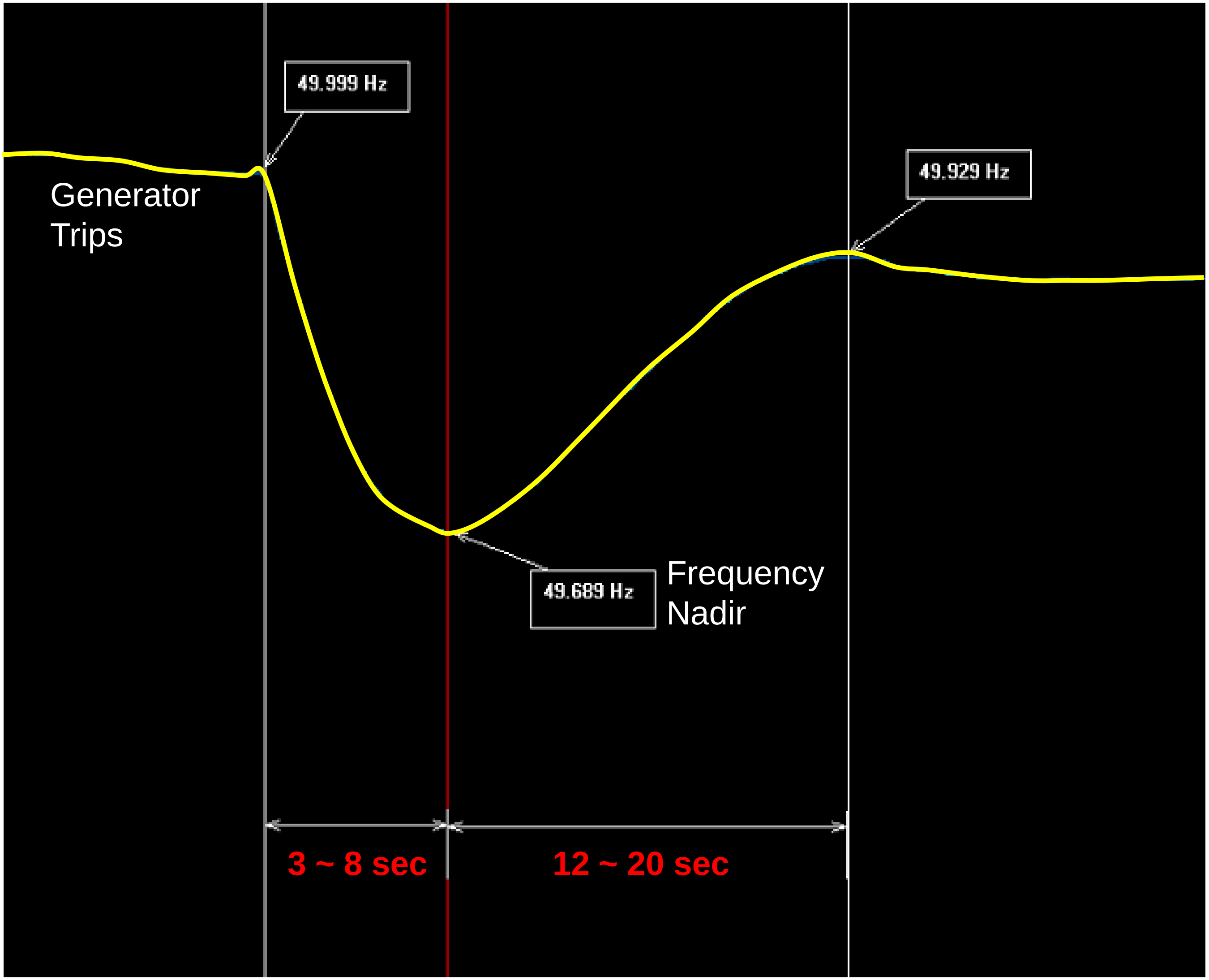
OC3 OPERATING RESERVE

When a generator trips, it takes 3 to 8 seconds to reach frequency Nadir



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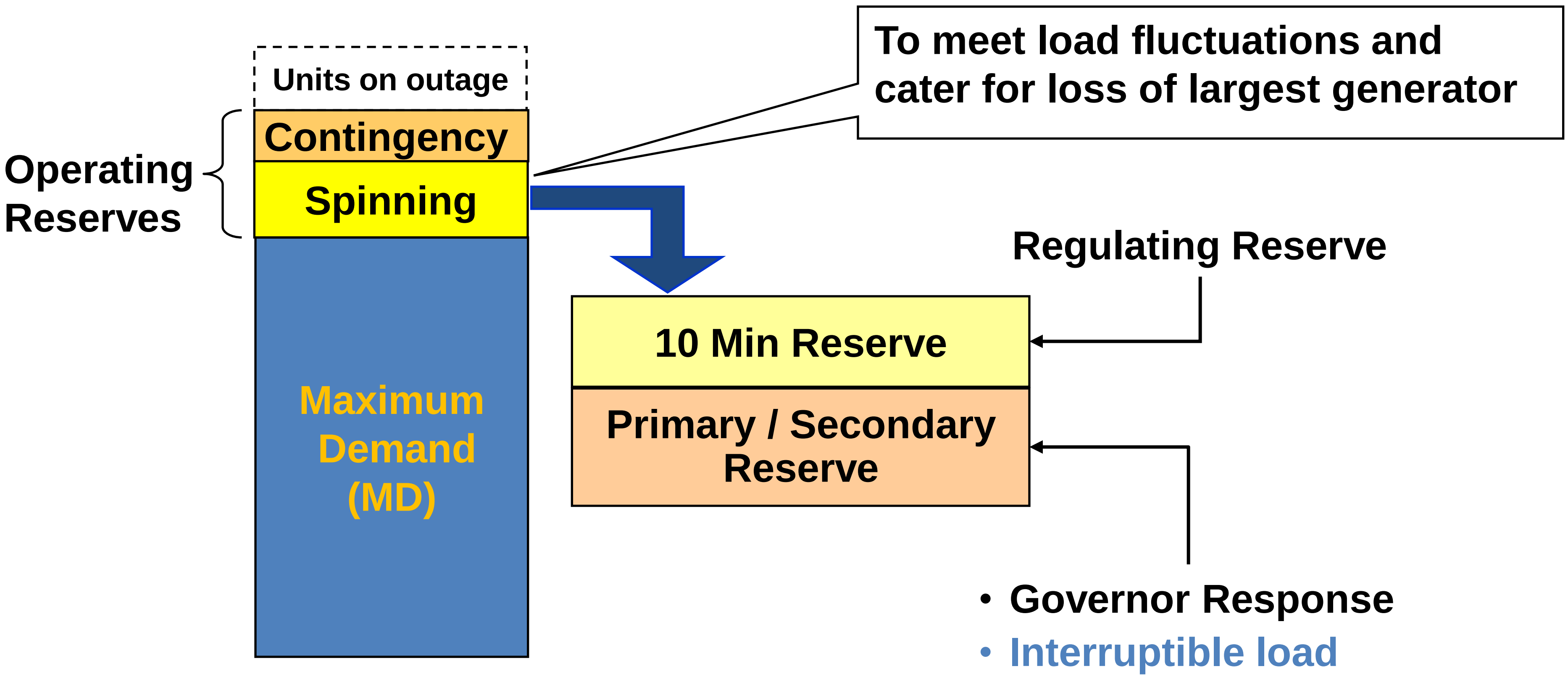
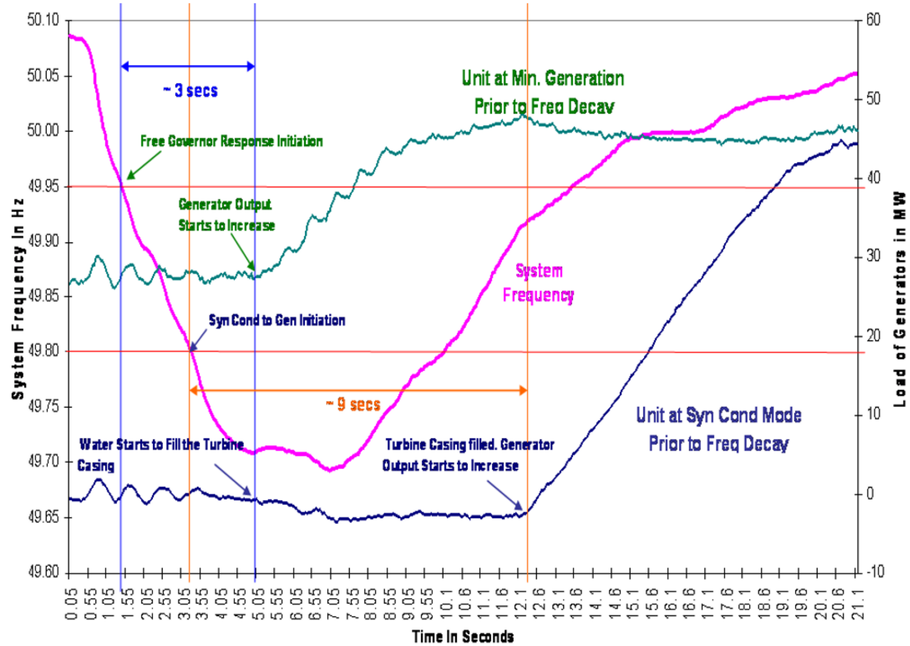
OC3 OPERATING RESERVE

Reliability = Adequacy + Security



OC3 OPERATING RESERVE

OC 3.4 Component of Operating Reserve



OC 3.4.1 Spinning Reserve

i. **Primary *Reserve***

Increase in output of a generator fully available in 5 seconds and sustainable for 25 seconds

ii. **Secondary *Reserve***

Increase in output of a generator fully available in 30 seconds and sustainable for 30 minutes

iii. **Demand Control**

Load connected to UFLS relays

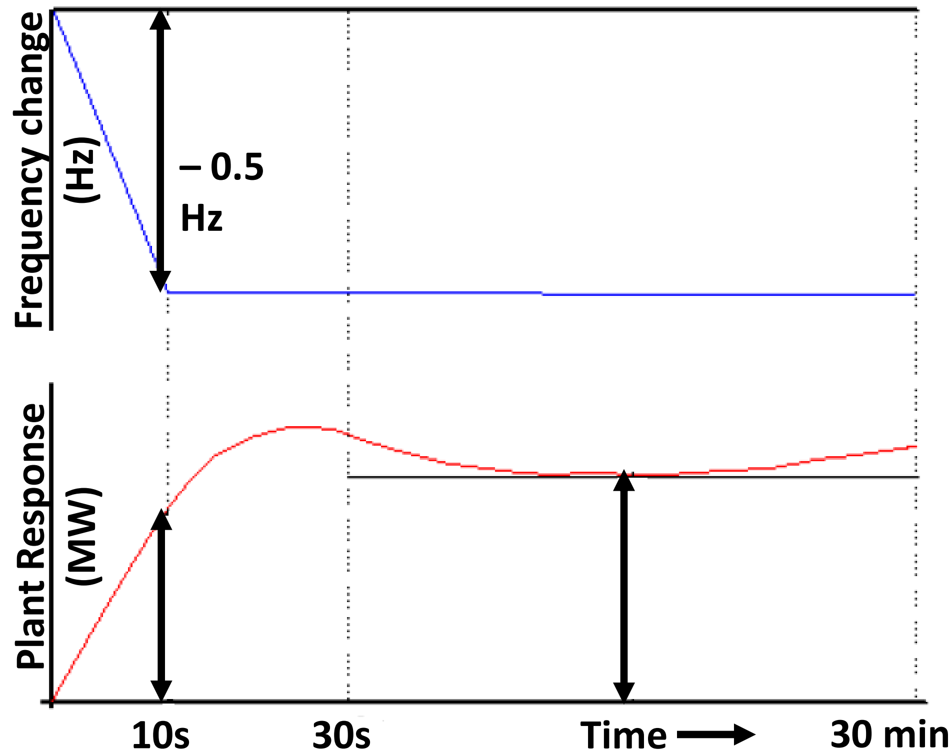
iv. **High Frequency Response**

Output of generator reduces in response to rise in frequency

Primary and Secondary Responses

The descriptions as per latest revision of NGC Grid Code

Primary Response:
The automatic increase in Active Power output of a Genset or, as the case may be, the decrease in Active Power Demand in response to a System Frequency fall. It will be released increasingly with time over the period 0 to 10 seconds from the time of the start of the Frequency fall



Secondary Response:
The automatic increase in Active Power output of a Genset or, as the case may be, the decrease in Active Power Demand in response to a System Frequency fall, fully available by 30 seconds from the time of the start of the **Frequency** fall and be sustainable for at least a further 30 minutes.

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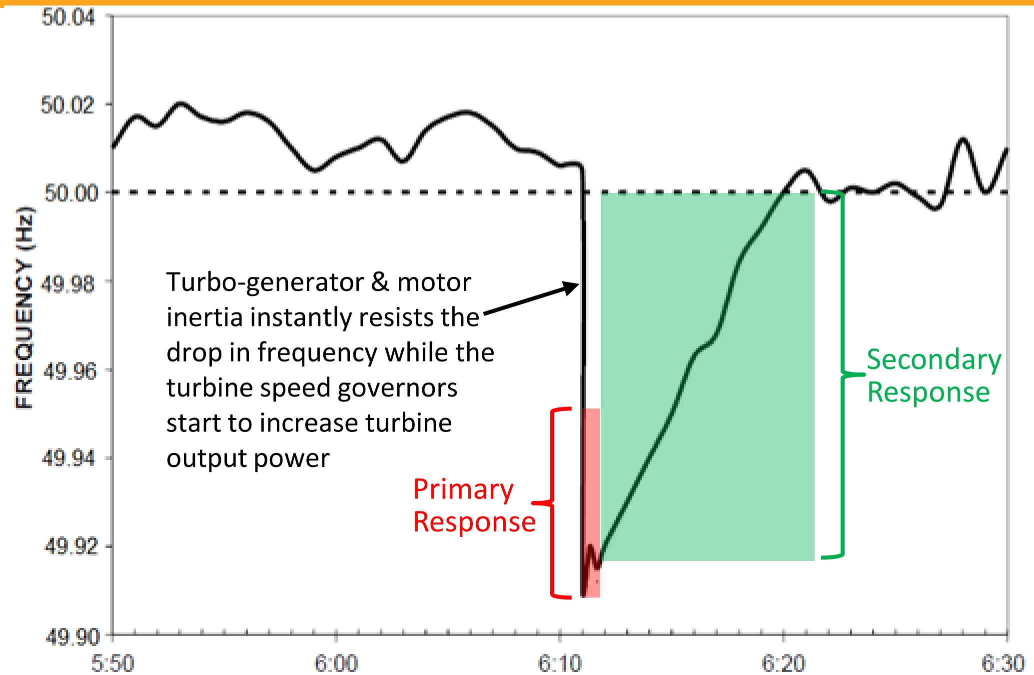
NERC's Definition

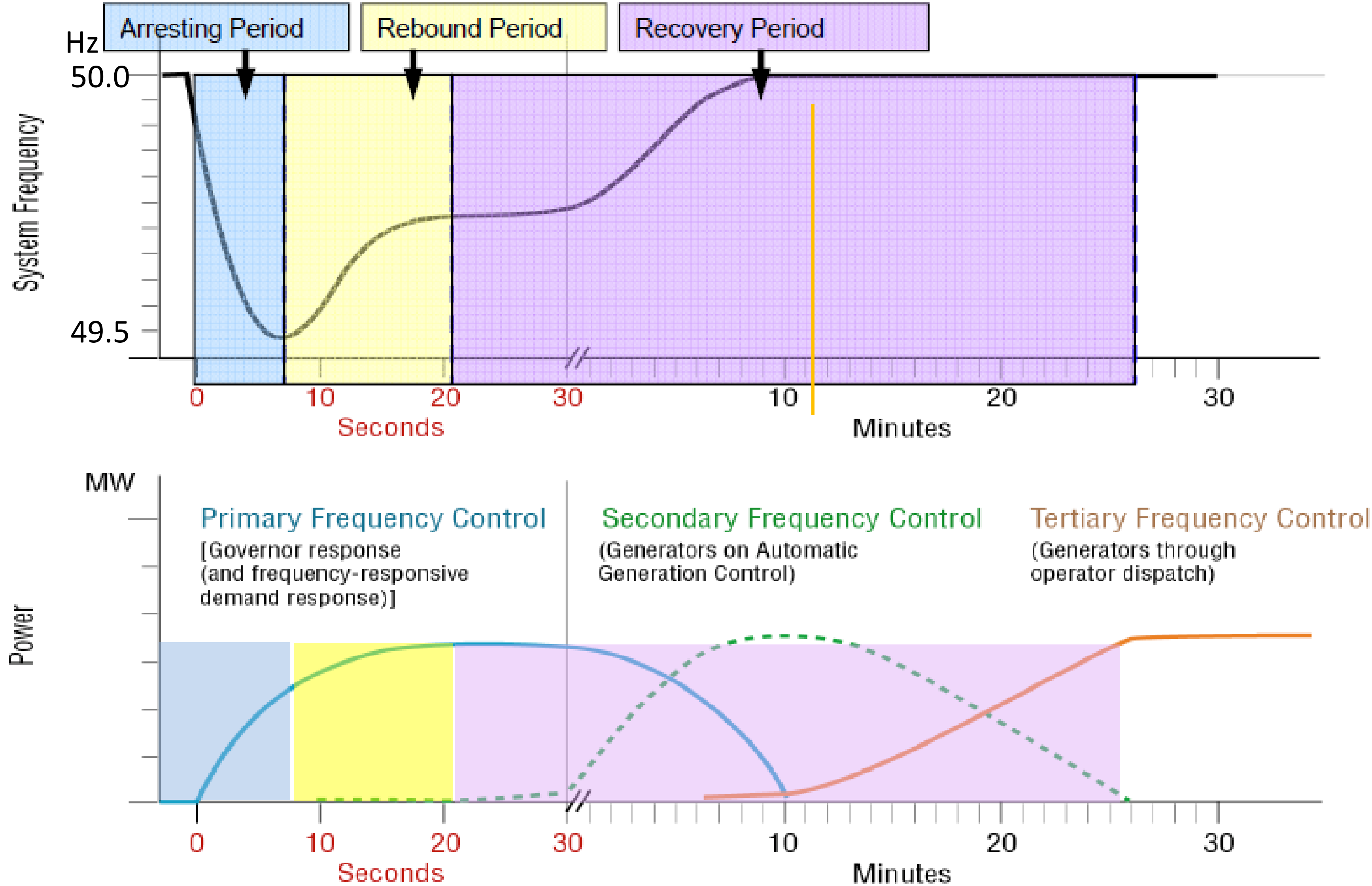
Frequency Response

Frequency response is a measure of a system's ability to stabilize frequency immediately following the sudden loss of generation or load. Frequency response is provided in two stages: the primary frequency response and the secondary frequency response.



- **Primary Frequency Control (Frequency Response)** – Actions provided by the System to arrest and stabilize frequency in response to frequency deviations. Primary Control comes from automatic generator governor response, load response (typically from motors), and other devices that provide an immediate response based on local (device-level) control systems.
- **Secondary Frequency Control** –Actions provided by generating units which will restore both Scheduled Frequency and Primary Frequency Response. Secondary Control comes from either manual or automated dispatch from a centralized control system.

Responses of Generators to Frequency Dip



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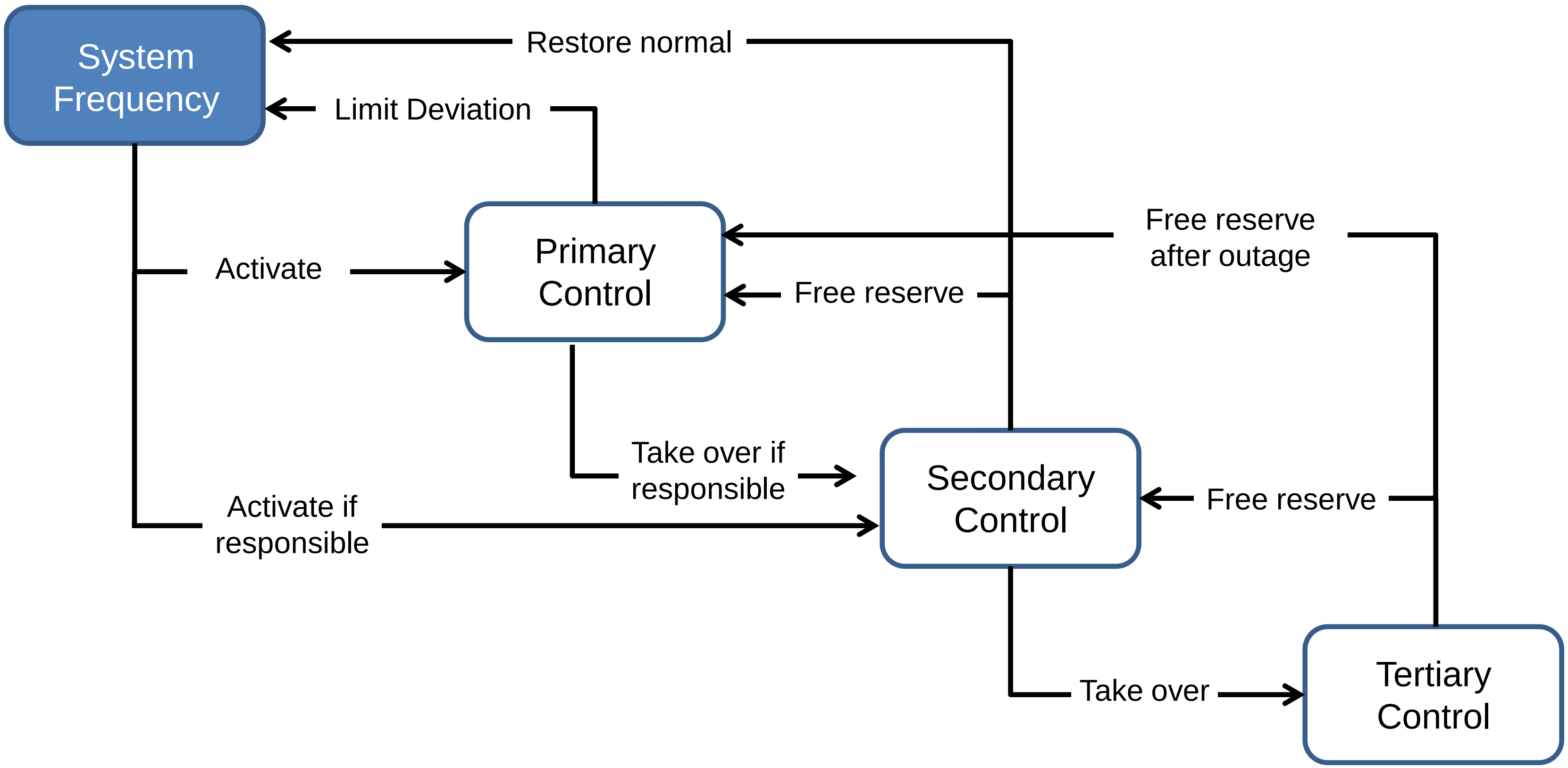
OC3 OPERATING RESERVE

Interaction Primary, Secondary & Tertiary Frequency Control

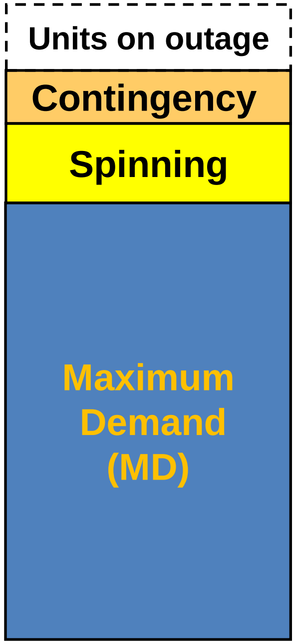


OC3 OPERATING RESERVE

OC 3.4.2 Non-spinning Reserve

i. **Hot Standy**
CDGU that can be synchronised and attain an instructed load within 30 minutes and maintain such load continuously

ii. **Cold Standby**
CDGU that are declared available and able to start and synchronised to System within a period of time stated in Availability Notice



OC 3.5 Allocation of Operating Reserve

OC3.5.1 Spinning Reserve

Quantum of spinning reserve to cater for forecasting error + single largest credible contingency such as:

a) Loss of largest generating unit

b) Loss of *largest transmission corridor*

What is the Spinning Reserve policy in SESB?

How to you take care of these two?

OC3.5.2 Non-Spinning Reserve

Why need this statement?

In order to cover for abnormal Demand forecasting errors or CDGU breakdown, a basic allocation of CDGUs for Hot Standby purposes shall be kept available up to at least one hour after system Peak Demand. The Non-Spinning Reserve allocation shall be determined from time to time by the GSO or RSO in accordance with OC3 and OC4

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OC4 Demand Control

OC4 DEMAND CONTROL

Reliability = Adequacy + Security

To preserve i**ntegrity** of the Grid System when supply is not able to cater for the demand or there is a severe over loading of Apparatus or Plants, GSO needs to initiate reduction in demand either manually or automatically using installed devices

Another consideration is the supply/demand balance when the network is split into islands during a major system disturbance

OC 4.4 Methods Used

(a)Automatic under frequency load shedding (UFLS) schemes; — **Security**

(b)Demand reduction initiated by GSO

(c)Consumer Demand Management initiated by GSO

(b) and (c) — **Adequacy**

OC 4.5 Procedures

OC 4.5.1 Automatic Under Frequency Load Shedding (UFLS) Scheme

Most utilities wired up between 30 to 60 % of demand to the UFLS schemes

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OC4 DEMAND CONTROL

OC 4.5.2 Demand Control Initiated by GSO

GSO may initiate demand reduction manually or through automatic SCADA or through 5% or 10% voltage reduction.

- *Tests carried out by Independent Electricity System Operator (Ontario) shows 2.5% reduction in demand with 5% reduction of voltage.*
- *Can one do a voltage reduction of 10%?*

OC 4.5.3 Consumer Demand Management

GSO has prior agreement with LPC's to shed part of their load (manually or using UFLS relay) in the event of insufficient generation.

OC 4.6 Implementation of Demand Control

During the implementation of demand control, Scheduling and Disptach in accordance to SDC is suspended.

OC 4.7 Implementation of UFLS Scheme

Why need to implement UFLS Scheme?

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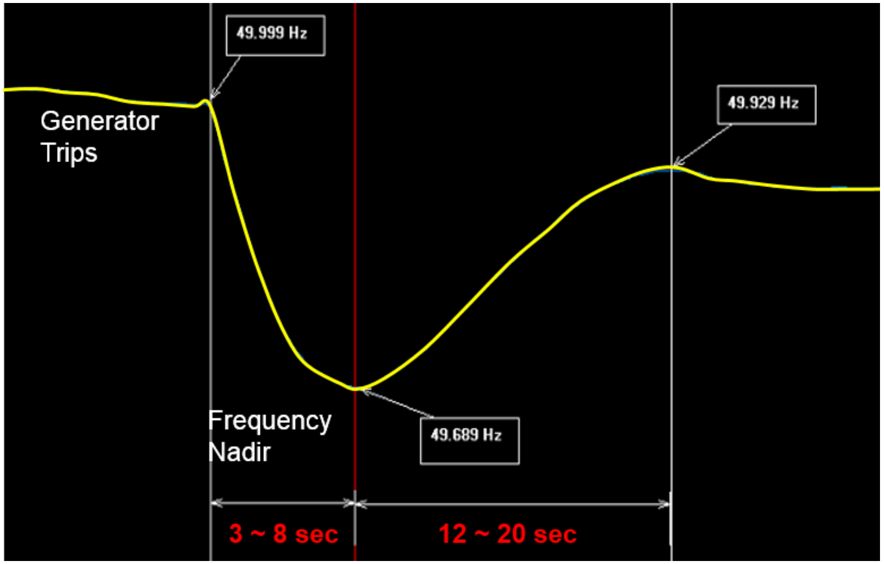
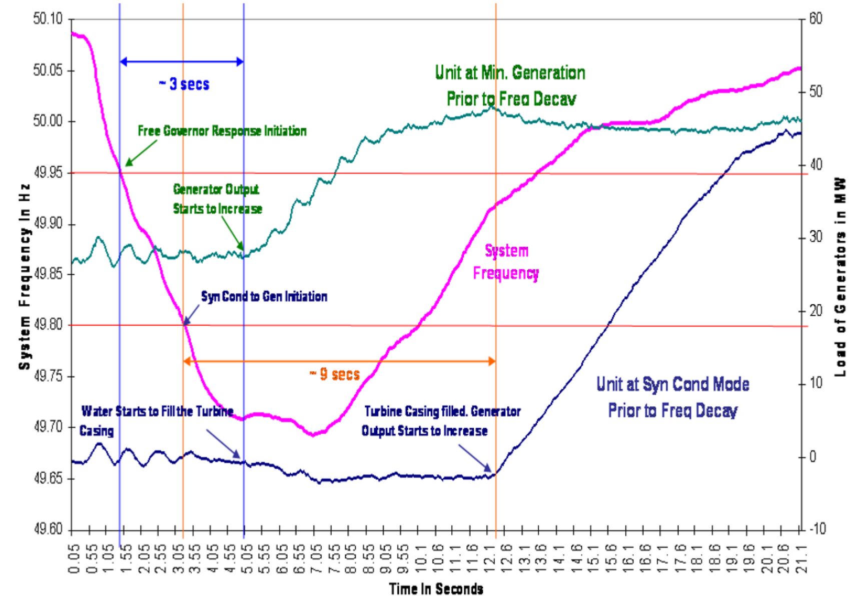
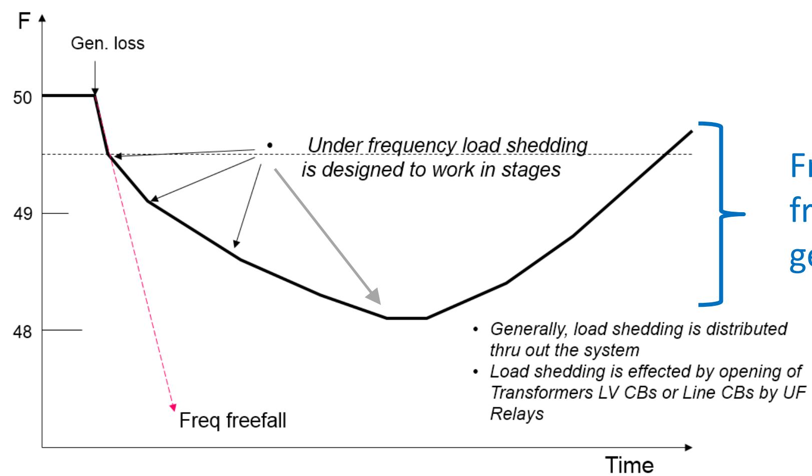
OC4 DEMAND CONTROL





The objective is to restore system load/generation balance, stabilize the system frequency and prevent turbine blades from permanent damage.



Frequency recovery due to free governor actions of generators

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OC4 DEMAND CONTROL

Table 4.7-1: Indicative Load Shedding Stages

LOAD SHEDDING STAGE	FREQUENCY, Hz	TIME DELAY, sec	INDICATIVE LOAD[1] REDUCTION, %	CUMULATIVE REDUCTION, %
I	49.4	0.10	10%	10%
II	49.3	0.10	20%	30%
III	49.2	0.10	10%	40%
IV	49.1	0.10	10%	50%
V	49.0	0.10	10%	60%
VI	48.8	0.10	10%	70%
VII	48.6	0.10	10%	80%
VIII	48.4	0.20	10%	90%
IX	48.2	0.20	10%	100%

This is target load reduction subject to review by the GSO or an RSO. During light load conditions, actual values will be some 50% - 60% of these peak values.

Questions:

- Why is it necessary to put in time delay? Why want increase the time delay in the last two stages?
- Why need to mentioned that during light load conditions, actual load will be some 50 to 60% of peak values?
- When one has a total of 1,000MW of generators on bus to cater for a demand of 700MW, i.e. the spinning reserve is 300MW. If a 200MW generator trips, is UFLS operation necessary?

OC 4.8 Implementation of Demand Control

OC 4.8.1 Types of Warnings Issued

(i) Yellow Warning

Issued by GSO when the risk of serious system disturbances is abnormally high. Power Stations and substations affected will be alerted & maintained in the condition that best able to withstand the disturbances

(ii) Orange Warning

Issued by GSO during periods of protracted generation shortage or periods of high risk of a disturbance. Network Operators to strategise their utilisation of manpower resources in rota disconnection. Estimates of the quantum of Disconnections required together with the time and duration of the Demand reductions likely to be enforced are to be included in the warning

(iii) Red Warning

Warning to be given when disconnection of consumer demand is imminent. Network Operators have to carried out disconnection promptly when such instruction is issued.

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OC 4.8.2 Warnings of Possibility of Demand Reduction

Warnings may be issued via telephone. During protracted periods of generation shortage, exceeding several days, Orange Warning shall be issued based on the best information available at the time and indicate the amount of Demand reduction that is anticipated. Confirmation of any modification of an Orange Warning should be issued as soon as possible.

OC4.8.3 Purpose of Warning

The purpose of warnings is to obtain the necessary Demand relief with the least possible inconvenience to Consumers and to ensure the response to requests for disconnection is both prompt and effective. Demand reduction may be required without warning if unusual and unforeseen circumstances create severe operational problems.

OC 4.8.4 Conditions Requiring Controlled Demand Reduction

(i) **Temporary Generation Shortage or Power System Overload**

Where possible voltage reduction should precede any Disconnection stages.

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OC4 DEMAND CONTROL

(ii) **Protracted Generation Shortage or Power System Overloading**

Protracted deficiency of generation shall be met by the use of voluntary Demand Reduction by LPC and where necessary Disconnection of Customers. Rota Disconnection plans shall be made by Network Operators and implemented on instruction from GSO.

(iii) **Demand Reduction Due To Concern about Stability**

Large imbalance between generation and Demand within a region may cause power insecure power transfer across regions risking the stability of the system. Hence it is necessary to reduce Demand in the affected region.

(iv) **Rota Disconnection Plans**

Addressed in (ii) above. Need to review the plan annually.

(v) **Situation Requiring Rapid Demand Reduction**

Where Demand reduction is inadequate to relieve unacceptable Power system conditions, UFLS scheme takes over as described in OC 4.7

OC 4.9 Demand Restoration

Demand restoration can only be initiated under the instruction of GSO.

OC5 Operational Liaison

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OC5 OPERATIONAL LIAISON

OC 5.1 Introduction

OC 5 sets out the requirements to exchange information related to Operations and/or Events on the Power System or a User Installation which have had or may have an Operational Effect on Power System or other User's installation.

OC 5.4 Operational Liaison Terms

Operation: previously planned and instructed action relating to the operation of any Plant or Apparatus.

Event: unscheduled or unplanned occurrence on or relating to a Power System including faults, incidents and breakdowns and adverse weather conditions experienced

Operational Effect: any effect on the operation of the relevant Power System which will or may cause the Power System or the User's installation to operate differently to the way which it would normally operate in the absence of that effect.

OC 5.5 Procedures for Operational Liaison

GSO, Network Operator and Users nominate persons, contact locations and agree on the communication channels to be used in accordance with Connection Conditions.

Information shall be exchanged on reasonable request from either party.

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OC 5.5 Procedures for Operational Liaison (Contd)

In the case of an Operation or Event on a User installation that will have or may have an Operation Effect on the Power System or other User's installation, User's that created the Operational Effect shall notify GSO who in turn inform other Users who in its reasonable opinion may be affected by that Operational Effect.

OC 5.6 Requirement to Notify

Examples of Operations where notification by GSO or Users may be required are:

(a) implementation of planned outage of Plant or Apparatus pursuant to OC2;

(b) the operation of circuit breaker or isolator/disconnector;

(c) voltage control; and

(d) on-load fuel changeover on CDGU

Examples of Events where notification by GSO or Users may be required are :

(a) operation of Plant and/or Apparatus in excess of its capability or which may pose a hazard to personnel;

(b) activation of an alarm or indication of ab abnormal operating condition;

(c) adverse weather condition;

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(d) breakdown of or faults on or temporary changes in, the capability of Plant and/or Apparatus ;

(e) breakdown of or faults on, control, communication and metering equipment;

(f) increased risk of unplanned protection operation; and

(g) abnormal operating parameter, such as governor problem, fuel system trouble, high temperature etc.

OC 5.6.1 Form of Notification

Notification should contain sufficient detail to describe the Operation or Event that might lead or has led to an Operational Effect on the Power System to enable recipient of notification to reasonably consider and assess the implications or risks arising from it

Verbal notification has to be written down by recipient and repeat back to the sender to confirm its accuracy .

OC 5.6.2 Timing of Notification

Notification under OC5 for Operations which will or may have an Operational Effect shall be provided as far in advance as practical AND at least 3 Business Days in advance

Notification for Events shall be provided within 3 Business Days after occurrence

OC6 Significant Incident Reporting

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OC6 SIGNIFICANT INCIDENT REPORTING

OC 6.1 Introduction

OC6 sets out the requirements for reporting in writing the Significant Incidents which were initially reported under OC5 including faults and breakdowns. Reporting of Total Blackout or Partial Blackout arising from OC7 shall be reported in accordance with OC6.

OC6 provides for joint investigation of Significant Incidents.

OC 6.4 Procedure for Reporting Significant Incidents

A Significant Event will include but not limited to:

(a) manual or automatic unplanned operation of Pant and/or Apparatus;

(b) power System voltage outside Normal Operating Condition limits;

(c) any breach of safety rules or operating procedures which result in or poses a risk of injury to personnel or damage to Plant or Apparatus;

(d) frequency outside Normal Operating Condition limits; and

(e) Power System Instability

Any Event that could have resulted in any of the above Operational Effects may be investigated under OC6 if GSO or User requires.

GSO shall be responsible for compilation of the final report and issue the report to all relevant parties including the Commission.

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OC6 SIGNIFICANT INCIDENT REPORTING

OC 6.5.1 Form of Report

The written report should include as a minimum contain the following details:

(a) Date, time and duration of the Significant Incident;

(b) Location;

(c) Apparatus and/or Plant involved;

(d) Brief description of Significant Incident under investigation; and

(e) Conclusion and recommendations of corrective actions if applicable.

OC6.5.2 Timing of Report

(i) Preliminary Report;

Preliminary Significant Incident report within 4 hours of the GSO or User receiving notification under OC5 that the Event is deemed to be a Significant Incident

(i) Full Report

Full written Significant Incident report within 3 Business Days of GSO or User receiving notification under OC5 that the Event is deemed to be a Significant Incident

GSO shall submit a preliminary report within 3 Business Days and final report within 2 calendar months

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OC 6.6 Procedure for Joint Investigation

Where a Significant Incident has been declared and a report submitted under OC6.4, the affected party or parties may request in writing that a joint investigation should be carried out.

The composition of the joint investigation panel shall be appropriate to the incident to be investigated and agreed upon by the parties involved. If an agreement cannot be reached then the Commission shall decide.

The form and procedures and all matters relating to the joint investigation shall be agreed by parties acting in good faith and without delay at the time of investigation. The investigation must begin within 10 Business Days from the date of the occurrence of the Significant Incident

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OC7 Contingency Planning and System Restoration

This Programme is Funded by Akaun Amanah Industri Bekalan Elektrik （AAIBE）

OC7 CONTINGENCY PLANNING AND SYSTEM RESTORATION

Critical Incident is an Incident or series of Incidents which would, in the reasonable opinion of the GSO result in the Power System frequency or voltage exceeding the operational limits as contained in the Planning Code. It can be caused by natural events such as storms or by equipment failure or accidental or intentional human acts.

System Stress is a condition of a Power System when the GSO reasonably considers that a single credible incident would most probably result in the occurrence of Partial Blackout, Power Islands, and/or Total Blackout. Normally such system stress would only apply across the periods of system Peak Demand. It can result from insufficient Operating Reserve or a shortage of Capacity in a Network. (?)

OC4 sets out procedures for notification by GSO of expected periods of System Stress. OC7 covers the implementation of recovery procedures following Critical Incidents that occur during System Stress (?)

System Stress covers periods of: (this contradicts the previous description)

(a) A Total System Blackout or Partial System Blackout

(b) The separation of the Grid into one or more Power Islands with associated loss of synchronisation or unexpected tripping of parts of the System

(c) Voltage collapse of a transmission circuit (?)

(d) Loss of strategic transmission group(?)

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OC7 CONTINGENCY PLANNING AND SYSTEM RESTORATION

OC 7.4.1 Power System Restoration

Generic tasks in the Power System Restoration Plan are:

(a) re-establishment of full communication between parties;

(b) determination of status of the Power System;

(c) instructions by GSO to relevant parties;(?)

(d) mobilisation and assignment of personnel;

(e) preparation of Power Stations and Power System for systematic restoration;

(f) re-energisation of Power Islands using Black Start Stations if necessary

(g) Re-synchronisation of various Power Islands to restore the interconnected Power System; and

(h) Audit of the Power System after restoration to ensure that the overall Power System is back to normal and all Demand is connected and in line with the reporting requirements of OC6 all data has been collected for reporting purposes.

Power System Restoration Plan will be developed and maintained by GSO in consultation with Network Operator and other appropriate Users. GSO to issue the Power System Restoration Plan and subsequent revisions to relevant Users and other parties.

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OC 7.4.2 General Restoration Procedures

Each User shall abide by the instructions of GSO during the restoration process, unless to do so would endanger life or could cause damage to Plant or Apparatus.

GSO may vary procedures in real-time where GSO in its reasonable opinion considers such a change is necessary.

OC 7.4.3 Determination of a Total Blackout or Partial Blackout

a) reports or data arriving at the LDC indicating a Power System split, or the existence of a risk to Plant or Apparatus that requires the Plant or Apparatus to be offloaded or shutdown, which itself constitutes a Critical Incident; or

b) reports or data from Power Stations indicating that a CDGU has tripped or needs to be offloaded, which by itself constitutes a Critical Incident..

Should change to

a) A total system collapse is a situation when all generation in the whole System has ceased and there is no electricity supply from External Interconnections i.e. the Total System has shutdown and require black starting.

b) Partial Blackout is when the System has broken into "islands" during a disturbance. The supply of some of these island have interrupted i.e. all the generators within these islands have ceased. But supply still maintained in one or more islands of the broken System

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OC 7.4.4 Restoration Preparation

GSO with Network Operator shall ensure that a systematic restoration process is conducted by energising each part of a Power Island in such a way to avoid tripping out CDGUs concerned by excessive load pick up. For Power Island that has gone black, begin the normalisation process from Black Start Stations to re-establish voltage and frequency in that Power Island.

Switching Guidelines

a) the LDC establishes its communication channels for the Power Island concerned;
b) the LDC sectionalises the Power System into pre-determined Power Islands;
c) *All Open Strategy is adopted for "Passive" circuits at substations (?)*
d) *Selective Open Strategy is adopted for "Active" circuits at substations (?)*
e) *a Feeding Strategy is adopted for the Black Start Power Stations and (?)*
f) *a Cross Feeding Strategy is adopted for utilising Black Start Power Stations to support the start up of other Power Stations in the same Power Island. (?)*

"Passive" circuits are those transmission circuits that do not have generation connected and which connect the Transmission Network to the Distribution Network and to the Load.

"Active" circuits are not "Passive" circuits and are those transmission circuits that have a CDGU connected and/or which adversely impact upon a CDGU's Dispatch capability if they are not available (for example due to creating a constraint on the CDGU).

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OC7 CONTINGENCY PLANNING AND SYSTEM RESTORATION

OC 7.4.5 Re-energisation and Demand Restoration

GSO to have detailed loading of each major feeder of *major substations in order that the CDGU's concerned shall not be presented with Load pickup in excess of the weakest CDGU's loading acceptance limit.(?)*

(d) At least one CDGU in each Power Island will operate in Frequency sensitive mode.(?)

OC 7.4.6 Synchronisation of Power Islands

Prioritise to synchronise Power Islands as they are formed as the bigger the network, the stronger is the grid.

OC 7.5 Power System Split Due to Unexpected Tripping (?)

Where the Power System becomes split it is important that any Power Islands that exist are re-synchronised as soon as practical to the main Power System, but *where this is not possible, Consumers should be kept on-supply from the Power Islands they are connected to.(?)*

Where CDGU's have shutdown and sections of the Network are experiencing blackout conditions, then GSO will have to consider the available generating Capacity including any Operating Reserve and prospective Demand that will be restored to ensure each Power Island operates within the frequency band given in PC. (?)

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OC7 CONTINGENCY PLANNING AND SYSTEM RESTORATION

OC 7.5 Power System Split Due to Unexpected Tripping (?)

In general, tripping under System Stress is considered to be that condition where following the tripping of a transmission circuit it is not possible to restore Power System interconnection due to a shortage of Operating Reserve (?)

Where Power Islanding occurs under System Stress then GSO should exercise rota load shedding programmes to avoid disconnected Consumers from being without supplies for extended periods. (?)

OC 7.5.3 Power System Restoration Plan Familiarisation and Training

Personnel who are expected to be involved with Power System Restoration should be familiar with and are adequately trained and experienced in their standing instructions. *GSO to arrange for simulator training (?)*

OC 7.5.4 Power System Restoration Test

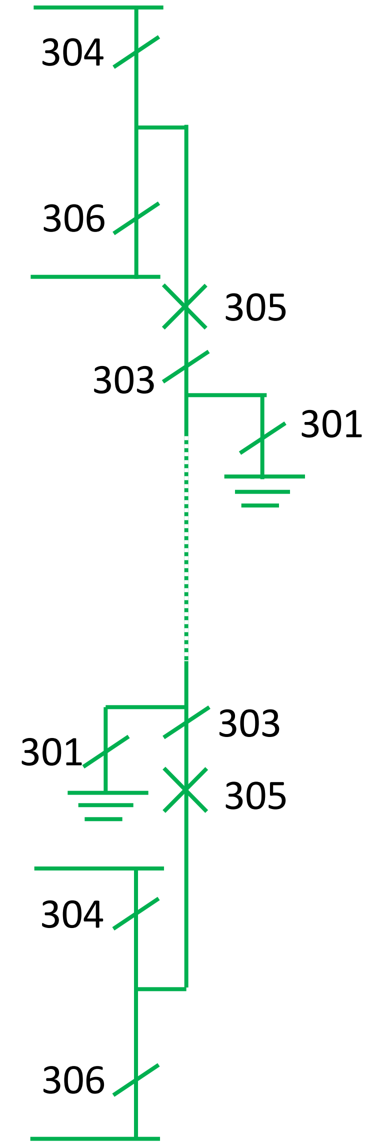
GSO shall in consultation with each User and Network Operator carry out a Power System Restoration Test at least once each year.

Both **OC7.6 Loss of Load Dispatch Centre** and **OC7.7 Fuel supply Shortages** need to be re-written

OC8 Safety Coordination

OC8 SAFETY COORDINATION

Switchgear Duties	Circuit Breaker	Isolator
Make & Break Small Charging Current*	Yes	Yes
Carry Load Current	Yes	Yes
Carry Short Term Fault Current	Yes	Yes
Make & Break Load Current	Yes	No
Make & Break Fault Current	Yes	No



Switchgear Types

Circuit Breakers

- Use to energise and de-energise equipment
- Able to break fault currents

Isolators

- Use to provide isolation
- To be operated under no load condition

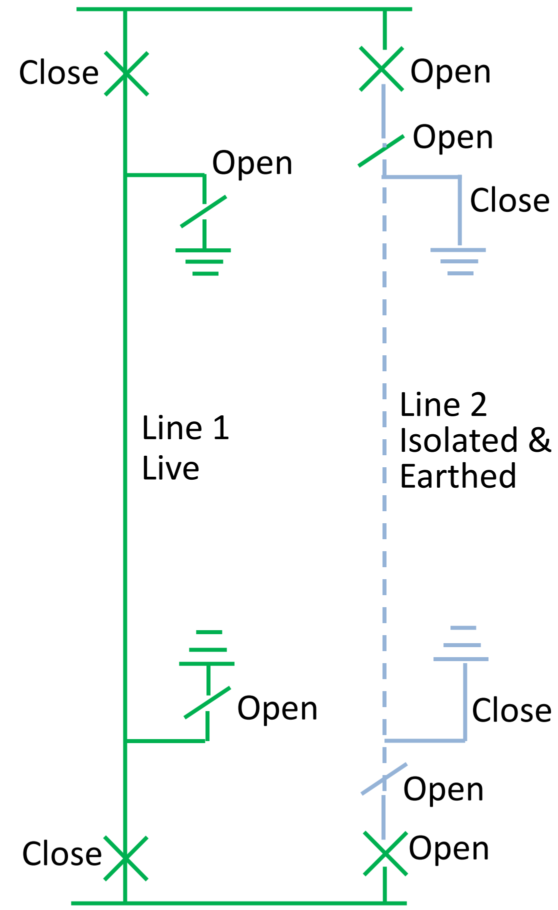
Earth Links

- Use to provide earth connection to equipment
- To be operated when equipment has been isolated

Local Earth

- Additional earthing connection to ensure that the conductor is properly earthed.

Is it safe to work on O/H Line 2 after it being isolated & earthed?



OC8 SAFETY COORDINATION

OC8.2 Objective

To ensure safe working conditions for personnel working on or in close proximity to Plant and Apparatus on the Power System or personnel who may have to work on or use the equipment at the interface between the Power System and a User System.

OC8.4.1 Defined Terms

HV Apparatus: High voltage electrical Apparatus forming part of Network

Isolation: disconnection or separation of HV Apparatus from the remainder of the Network

Isolating Position: must be maintained by immobilising and locking (with Safety Lock) of the Isolating Device in isolating position and affixing an Isolation Notice to it and must have **adequate physical separation** in accordance with and maintained by the method set out in the Local Safety Instructions.

Earthing: a way of providing a connection between HV conductors and earth by an Earthing device which is immobilised and locked in the Earthing positions.

Network Controller

Senior professional engineer responsible for the Network Operator's control centre who is responsible for site safety of that part of the Network where the User has its Connection Point

OC8 SAFETY COORDINATION

OC8.4.2 Approval of Local Safety Instructions before Commissioning

Each User will supply to the *relevant Network Controller* a copy of its Safety Rules and any Local Safety Instructions relating to its side of the Connection Point.

Prior to connection each party must have agreed the other's relevant Safety Rules and relevant Local Safety Instructions in relation to Isolation and Earthing and obtained the approval of the GSO to such instruction.

Any changes made to Local Safety Instructions relating to Isolation and Earthing to be made known and approval need to be seek if the provisions made are less stringent

OC8.4.3 Safety Coordinator

A person responsible for the coordination of safety precautions when work is to be carried out on a Network which necessitates the provision of Safety Precautions on HV Apparatus. *The names of these Safety Coordinators will be notified in writing to the **Network Controller** by User. The Network Controller will advise the User of the persons nominated by him as Safety Coordinators **for the User's site**.*

Requesting Safety Coordinator

Implementing Safety Coordinator

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HV Switching Work – Definitions

- ***Authorisation Certificate***
  - Issued by Officer In Control to Authorised Person (AP)
  - Details what equipment is isolated, earthed and safe to work
  - Allows issue of PTW
- ***Permit To Work***
  - Issued by Authorised Person to Competent Person
  - Details what equipment is dead, discharged, earthed and safe to work
- ***Dead***
  - At zero voltage & disconnected from any LIVE system
- ***Circuit Main Earth***
  - Approved earth applied before issue of PTW
- ***Additional Earth***
  - Approved earth applied after issue of PTW

Officer In Control is the switching engineer on duty at NLDC.

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HV Switching Work – Procedures

- *Authorised Person* requests *Authorsation For Work* on HV equipment from the *Officer-In-Control*
- *Officer-In-Control* isolates the HV equipment and apply *Circuit Main Earth*
- *Authorised Person may issue Permit to Work to a Competent Person in charge of a Working Party*
- *Competent Person* may apply *Additional Local Earth* and start work on the *Dead* HV equipment
- *Competent Person* stops all work, removes all *Additional Earths* and signs the *Clearance Certificate (at the back PTW)*
- *Authorised Person* requests *Officer-In-Control* to cancel the *Authorsation Certificate*
- *Officer-In-Control removes the Circuit Main Earth and begins restoring the HV equipment*

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OC8.4.4 Record of Safety Precaution (ROSP)

This part sets out the procedures for utilising the "Record of Safety Precautions" ("ROSP") between Users through the Network Controller or *between two Network Controllers.*

In order to ensure safety when work needs to be done at the interface Apparatus the party that request for the isolation will need to complete the form Record of Safety Precautions (ROSP-R) (Requesting Safety Coordinator's Record) and party that implement the necessary isolation as safety precautions need to complete the form Record of Safety Precautions (ROSP-I) (implementing Safety Coordinator's Record).

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OC8 - APPENDIX A

[SESB] ___________CONTROL CENTRE/SITE

RECORD OF SAFETY PRECAUTIONS (ROSP-R)

(Requesting Safety Coordinator's Record)

ROSP NUMBER _______________

PART 1

1.1 HV APPARATUS IDENTIFICATION

Safety Precautions have been established by the Implementing Safety Coordinator (or by another User on that User's System connected to the Implementing Safety Coordinator's System) to achieve safety from the Power System on the following HV Apparatus on the Requesting Safety Co ordinator's System: [state identity - name(s) and, where applicable, identification of the HV circuit(s) up to the Connection Point]:

____

____

Further Safety precautions required on the Requesting Safety Coordinator's System as notified by the Implementing Safety Co-ordinator.

____

____

1.2 SAFETY PRECAUTIONS ESTABLISHED

(a) **ISOLATION**

State the Location(s) at which Isolation has been established (whether on the Implementing Safety Coordinator's Network or on the Network of another User connected to the Implementing Safety Coordinator's Network). For each Location, identify each point of Isolation, state the means by Isolation has been achieved, and whether, immobilised and locked, Isolation Notice affixed and other safety procedures applied, as appropriate.

____

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(b) **EARTHING**

State the Location(s) at which Earthing has been established (whether on the Implementing Safety Coordinator's Network). For each location, identify each point of Earthing. For each point of Earthing, state the means by which Earthing has been achieved, and whether, immobilised and Locked, other safety procedures applied, as appropriate.

____

____

1.3 ISSUE

I have received confirmation from ______________________(name of the Implementing Safety Co ordinator) that the Safety Precautions identified in paragraph 1.2 have been established and that instructions will not be issued at his location for their removal until this ROSP is cancelled.

Signed_____________________ (Requesting Safety Coordinator)

at______________(time) on __________________(Date)

PART 2

2.1 CANCELLATION

I have confirmed to __________________________(name of the Implementing Safety Co ordinator) that the Safety Precautions set out in paragraph 1.2 are no longer required and accordingly the ROSP is cancelled.

Signed ___________________ (Requesting Safety Coordinator)

at__________ (time) on _____________________ (Date)

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OC8 - APPENDIX B

____________CONTROL CENTRE/SITE

RECORD OF SAFETY PRECAUTIONS (ROSP-I)

(Implementing Safety Coordinator's Record)

ROSP NUMBER _______________

PART 1

1.1 **HV APPARATUS IDENTIFICATION**

Safety Precautions have been established by the Implementing Safety Coordinator (or by another User on that User's Network connected to the Implementing Safety Coordinator's Network) to Safety From The Power System on the following HV Apparatus on the Requesting Safety Coordinator's System: [state identity - name(s) and, where applicable, identification of the HV circuit(s) up to the Connection Point]:

____

____

Recording of notification given to the Requesting Safety Coordinator concerning further Safety Precautions required on the Requesting Safety Coordinator's Network.

____

____

1.2 **SAFETY PRECAUTIONS ESTABLISHED**

(a) **ISOLATION**

State the location(s) at which Isolation has been established (whether on the Implementing Safety Coordinator's Network or on the Network of another User connected to the Implementing Safety Co ordinator's Network). For each location, identify each point of Isolation, state the means by which Isolation has been achieved, and whether, immobilised and locked, Isolation Notices affixed, other safety procedures applied, as appropriate.

____

____

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OC8 - APPENDIX B

(b) **EARTHING**

State the Location(s) at which Earthing has been established (whether on the Implementing Safety Coordinator's Network). For each Location, identify each point of Earthing. For each point of Earthing, state the means by which Earthing has been achieved, and whether, immobilised and locked, other safety procedures applied, as appropriate.

____

____

1.3 **ISSUE**

I have received confirmation from ________________________(name of the Requesting Safety Co ordinator) that the Safety Precautions identified in paragraph 1.2 have been established and that instructions will not be issued at his location for their removal unit this ROSP is cancelled.

Signed_______________________ (Implementing Safety Coordinator)

at________________(time) on ____________________(Date)

PART 2

2.1 **CANCELLATION**

I have confirmed to ____________ _________ __(name of the Requesting Safety Coordinator) that the Safety Precautions set out in paragraph 1.2 are no longer required and accordingly this ROSP is cancelled.

Signed _____________________ (Implementing Safety Coordinator)

at____________ (time) on _______________________ (Date)

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OC9 Numbering & Nomenclature

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OC9 NUMBERING AND NOMENCLATURE

OC9.2 Objective

To reduce chances of human error when performing switching on Plants and Apparatus. GSO shall provide the unique numbering and nomenclature of all Plant and Apparatus that forms the Power System or is directly connected to the Power System and shall keep a register to keep track of the numbering and nomenclature given.

(In the current Grid Code, Power Producers and Large Power Consumers have the rights to come up with the numbering provided it is not confused with that of Network Operator or other User at the Connection Point)

OC9.4.1 New Plant and Apparatus

Network Operator or User intending to install new Plant and/or Apparatus at existing Connection Point or a new Connection Point shall notify GSO at least 90 days in advance prior to the installation of the proposed Plant and Apparatus and GSO to respond within 30 calendar days of the receipt of such notification whether the proposed numbering and nomenclature is acceptable or not.

In the event that agreement cannot be reached, GSO acting reasonably shall determine the appropriate numbering and nomenclature.

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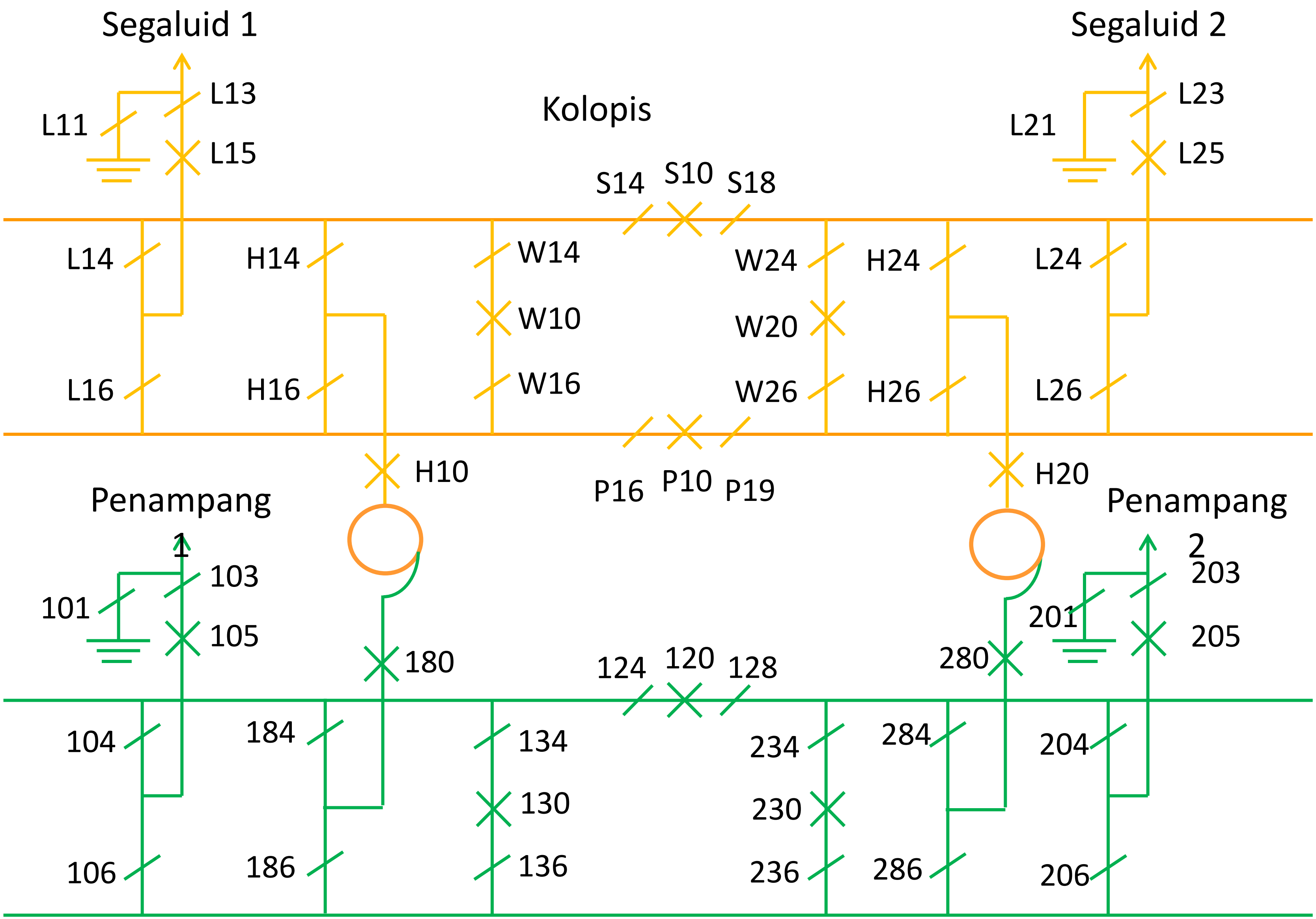
OC9 NUMBERING AND NOMENCLATURE



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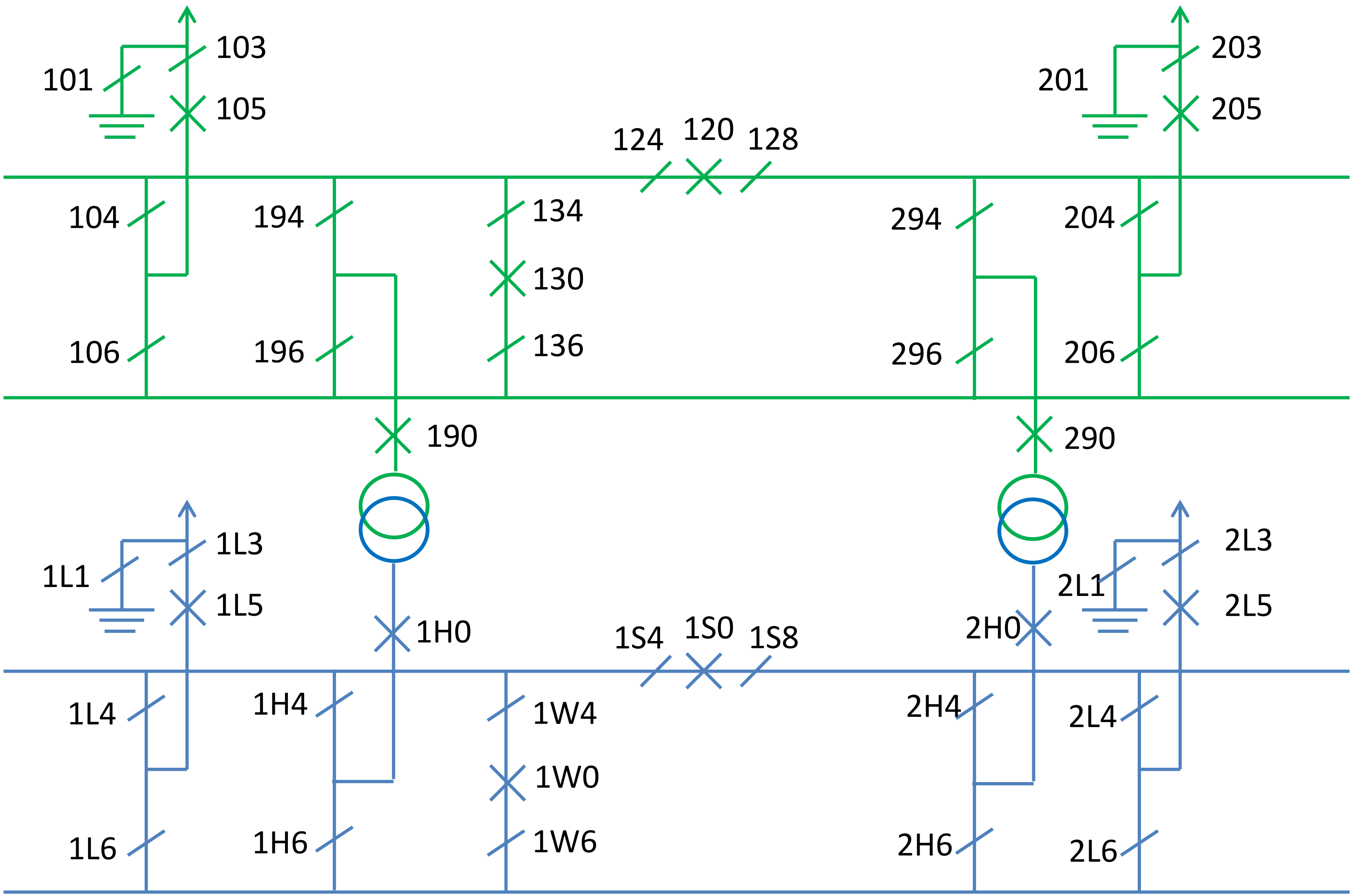
OC9 NUMBERING AND NOMENCLATURE



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OC10 Testing and Monitoring

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OC10 TESTING AND MONITORING

OC10.1 Introduction

Operating Code No. 10 (OC10) specifies the procedures to be followed by the GSO in carrying out the following functions:

(a) testing and monitoring to ensure compliance by Users with the PC and CC;

(b) testing and monitoring of CDGUs against Generating Unit Scheduling and Dispatch parameters registered under Scheduling and Dispatch Code No. 1 (SDC1);

(c) testing carried out on CDGUs to ensure that the CDGUs are available in accordance with their Availability declaration, under the Scheduling and Dispatch Code (SDC) and other appropriate agreements;

(d) testing carried out on CDGUs to test that they have the capability to comply with the CC and, in the case of response to frequency, SDC3; and

(e) testing of the provision by Users of Ancillary Services which they are required or have agreed to provide, including the provision of any Black Start services required.

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OC10 TESTING AND MONITORING

OC10.4 Procedures Relating to Quality of Supply

- GSO to make a written request to the User for carrying out such test 5 Business Days prior to the day of the proposed test
- Within 90 calendar days after completion of such testing and/or monitoring GSO will make available the results of such test to the User.
- User will be informed in writing if the results of such test show that the User is operating outside the technical parameters specified in the Grid Code.
- GSO shall agree with the User a suitable timeframe to resolve the issues of non compliance. Failure to comply may lead to the de-energisation of the User's system as indicated in the terms of the Connection Agreement.

OC10.5 Procedures Relating to connection Point Parameters

- This monitoring related to the amount of Active Power and/or Reactive Power swing or voltage flicker or voltage sag/swell and any harmonics generated by the User System
- GSO may check for compliance with agreed protection requirements and protection settings.

OC10 TESTING AND MONITORING

OC10.6 Procedures Relating to Monitoring CDGU

OC10.6.2 Failure in Performance

- Persistence failure of CDGU to meet the parameters registered under SDC1 or Power Producer GSO to notify relevant User fails persistently fail to comply with SDC3 or provide the agreed Ancillary Services, GSO to notify the relevant User.
- User to provide GSO explanation of the reasons for failure and state reasonable time frame to take the necessary actions to meet those parameters.
- Within 14 calendar days of notification of failure, GSO/SB entitled to require a test as set out in OC10.7

OC10.7 Procedures Relating to Testing CDGU

GSO to give 2 days advance notice before carry out tests.

OC10.7 .1 Reactive Power Tests

The test will be initiated by the issue of Dispatch instructions under SDC2. Test duration up to 60 minutes during which period the Power System voltage at the Connection Point for the relevant CDGU will be maintained by the Power Producer at the voltage required by SDC2 through adjustment of Reactive Power on the remaining CDGUs, if necessary

OC10.7.2 Registered Generating Unit Scheduling and Dispatch Parameters

The test will be initiated by the issue of Dispatch instructions under SDC2. The duration of the test will be consistent with and sufficient to measure the relevant generation Scheduling and Dispatch Parameters.

CDGU will be considered to have passed the test if the following generation Scheduling and Dispatch Parameters are met :

a) Synchronisation is achieved with ± 5 minutes of the time it should have achieved Synchronisation;
b) the Loading achieved is within an error level equivalent to ± 2.5 % of Dispatched instructions;
c) the CDGU achieves the instructed output and, where applicable, the first and or second intermediate breakpoints, each within ± 3 minutes of the time it should have reached such output and breakpoint(s) from Synchronisation calculated from its contracted run-up rates;
d) if the CDGU achieves de-loading within ± 5 minutes of the time, calculated from registered de-loading rates; and
e) in the case of all other generation Scheduling and Dispatch Parameters not contained in (a) to (d) above, the test results are within ± 2.5 % of the declared value being tested.

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OC10.7.3 Availability Declaration Testing

The GSO may, in consultation with the Single Buyer, at any time carry out a test on the Availability of a CDGU by Scheduling and Dispatching.

GSO after consulting with the Single Buyer, will determine whether or not a CDGU has passed an Availability Test, in accordance with the procedures set out in the appropriate agreement and SDCs

OC10.7.4 Frequency Sensitive Testing

Testing of this parameter will be carried out as part of the routine monitoring under OC10.6 of CDGUs

a) where monitoring of the Primary Reserve and or Secondary Reserve and or High Frequency Response to Frequency change on the Power System has been carried out, the measured response in MW/Hz is within ±2.5 % of the level of response specified in the Ancillary Services agreement for that CDGU; (?)

b) measurements of the governor parameters are within the criteria as determined by the Single Buyer, GSO and

c) where monitoring of the limited High Frequency Response to Frequency change on the Power System has been carried out, the measured response is within the requirements of the SDC for limited frequency sensitive response; except for gas turbine Generating Units where the criteria set out in the CC shall apply (?)

OC10 TESTING AND MONITORING

OC10.7.5 Black Start Testing

(i) BS Generating Unit Test	(ii) BS Station Test
	(a) All Generating Units at the Black Start Power Station, other than the Generating Unit on which the Black Start Test is to be carried out (BSGU) and all the auxiliary gas turbines and or auxiliary diesel engines and or auxiliary hydro generators at the Black Start Power Station, shall be shut down
(a) The relevant Black Start Generating Unit (BSGU) shall be Synchronised and Loaded;	(b) The relevant BSGUs shall be Synchronised and Loaded;
(b) All the auxiliary gas turbines and or auxiliary diesel engines and or auxiliary hydro generator in the Black Start Station in which that BSGU is situated, shall be shut down;	
(c) The BSGU shall be de-Loaded and de-Synchronised and all alternating current electrical supplies to its auxiliaries shall be disconnected;	(c) The relevant BSGUs shall be de-Loaded and de-Synchronised;
	(d) All external alternating current electrical supplies to the unit board of the relevant BSGUs and to the station board of the relevant Black Start Power Station shall be disconnected;
(d) The auxiliary gas turbine(s) or auxiliary diesel engine(s) to the relevant BSGU shall be started, and shall re-energise the unit board of the relevant BSGU;	(e) An auxiliary gas turbine or auxiliary diesel engine or auxiliary hydro generator at the Black Start Power Station shall be started, and shall re-energise either directly, or via the station board, or the unit board of the relevant BSGU; and
(e) The auxiliaries of the relevant BSGU shall be fed by the auxiliary gas turbine(s) or auxiliary diesel engine(s) or auxiliary hydro-generator, via the BSGU's unit board, to enable the relevant BSGU to return to synchronous speed; and	(f) The provisions of items (e) and (f) in OC10.7.5 (i) above shall thereafter be followed.
(f) The relevant BSGU shall be Synchronised to the Power System but not Loaded, unless the appropriate instruction has been given by the GSO or RSO or Single Buyer under SDC2.	

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OC10 TESTING AND MONITORING

OC10.6 Procedures Relating to Monitoring CDGU

OC10.7.6 Failure of Test

- Within 5 Business Days after failure of test, Power Producer to give GSO/SB a written report specifying the reasons for any failure of the test. Should there be a disagreement pertaining to the failure of test, Power producer may by notice require GSO/SB to carry out a re-test after 2 Business Days notice.
- If the re-test fail again and a dispute arises from the re-test, either party may use the Grid Code dispute resolution procedure contained in General Conditions for a ruling in relation to the dispute. The ruling shall be binding.
- If Power Producer accepts the failure of test or re-test, a written report is to be submitted to GSO/SB for approval of the date and time by which the CDGU concerned will be brought to conditions where it complies with the relevant requirements set out in PC, CC or SDC and would pass the test.

OC10.8 Allocation of Cost for Tests

Test proposer shall bear the costs of the test if the subsequent test results indicate that the proposed tests is not justified otherwise the affected party to bear the cost

OC11 System Tests

OC11 SYSTEM TESTS

OC11.1 INTRODUCTION

A "System Test" is a test which involves either a simulated or a controlled application of irregular, unusual or extreme conditions on the Power System or a User System. In addition it includes commissioning and or acceptance tests on Plant and Apparatus to be carried out by a Network Operator or by Users which may have a significant impact upon the Power System, other User Systems

OC11.4 Procedure For Arranging System Tests which are reasonably expected to have a Minimal Effect (any distortion to voltage and frequency at Connection Points does not exceed the standards contained in this Code) upon the Power System, User Systems and or the wider System will not be subject to this procedure.

OC11.4.1 Test Proposal Notice

Some proposed tests can only be carried out at certain time period and certain days.

System Tests include

- Generator full load capability test
- VAR limiter tests
- Main steam valve tests
- Load rejection tests
- On-load protection tests
- Primary/secondary reserve test

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OC11 SYSTEM TESTS

System Test Process Timing

Test Proposer Test Proposal Notice	GSO Appointment of Test Panel	Test CoordinatorP re-test Report	Proposed Date of Test	Test Proposer Test Report

30 days | 30 days | 30 days | ? days

By

- Panel headed by Test Coordinator appointed by GSO
- Members are affected Users

- Report includes proposed switching sequence and timing to facilitate such test and personnel involved
- Each party pay its own reasonable cost. Test Proposer bear overtime or additional cost
- Report to be submitted to all affected Users

- Test Proposer shall submit a written report to GSO and if necessary to Single Buyer
- GSO may provide such report to relevant parties after considering confidentiality.

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THANK YOU

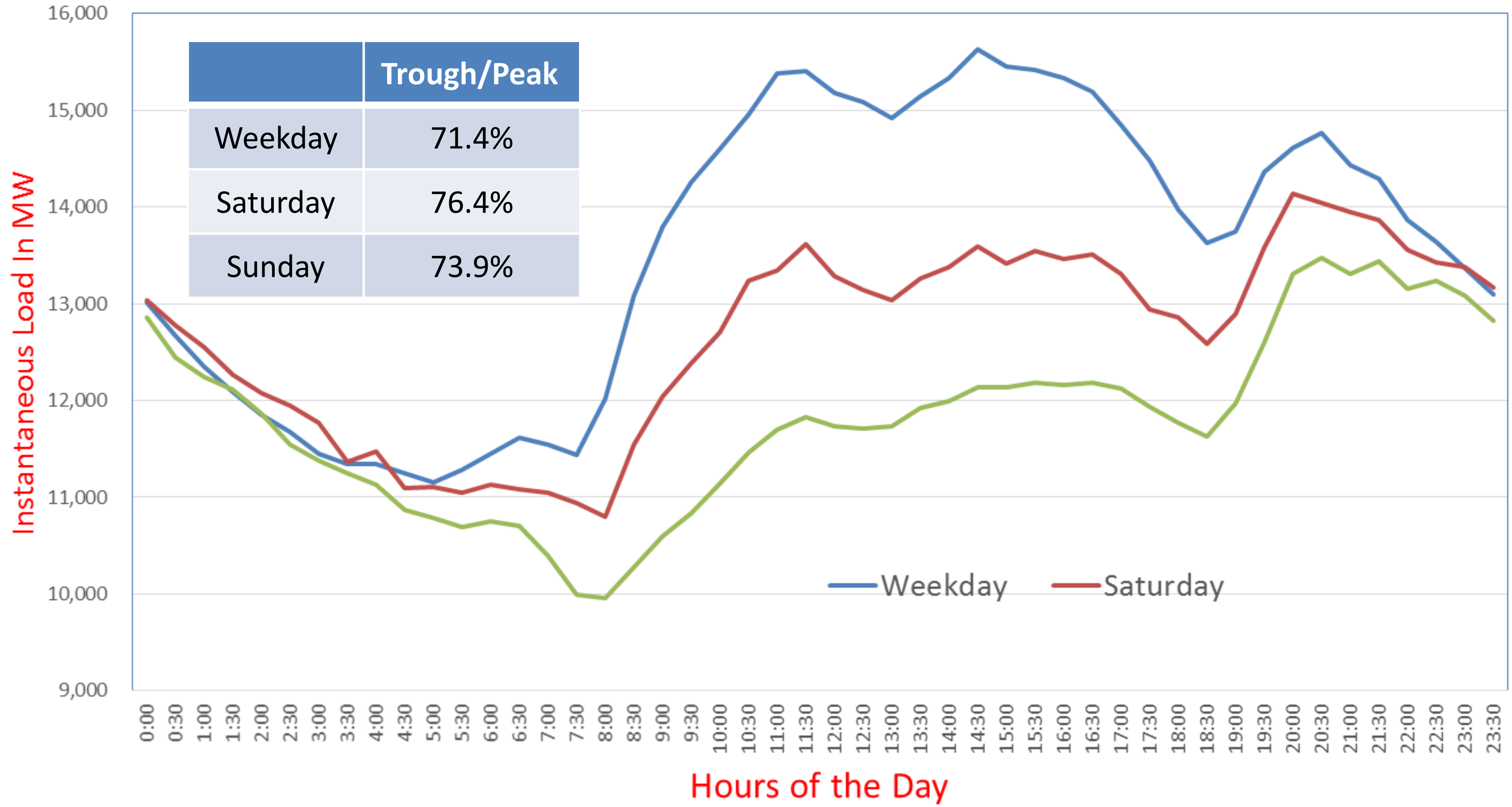
KeTTHA
KEMENTERIAN TENAGA, TEKNOLOGI HIJAU DAN AIR

Suruhanjaya Tenaga

Sabah dan Labuan Grid Code Awareness Programme Funded by Akaun Amanah Industri Bekalan Elektrik (AAIBE)

OC4 DEMAND CONTROL

Typical Daily Load Curves of Peninsular Malaysia Grid



	Trough/Peak
Weekday	71.4%
Saturday	76.4%
Sunday	73.9%

In Peninsular Malaysia Grid System, the ratio of trough vs peak demand is around 74%. In designing UFLS scheme, the quantum of load shed is based on peak load e.g. 55% of peak load. At other times, it is assumed that the load will be proportional (eg. 55%) to the system demand at that time

Back

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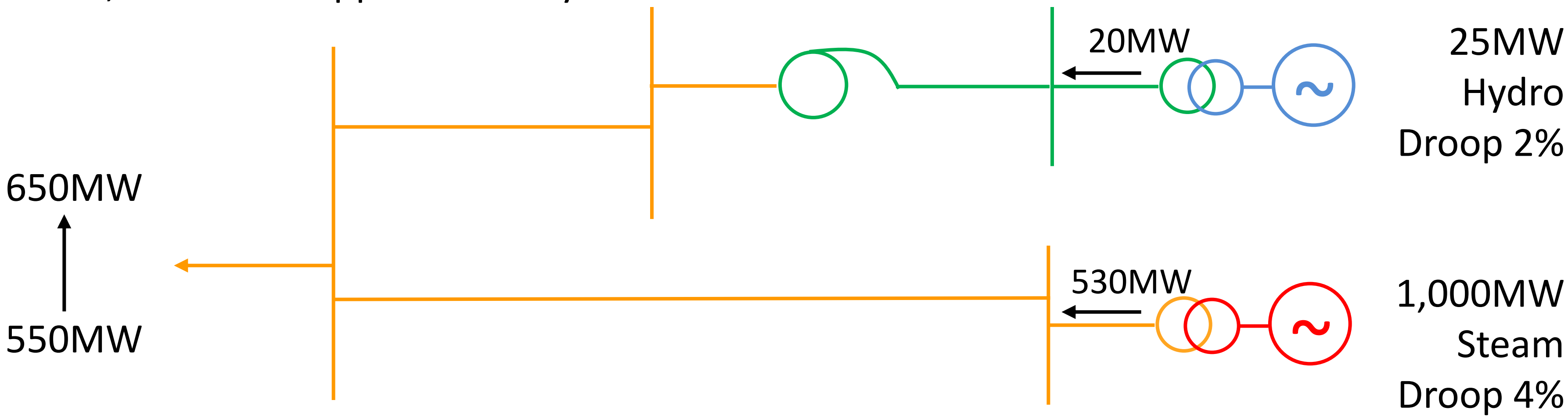
During system restoration, a 1,000MW generator is connected synchronously with a 25MW generator sharing a load of 550MW. GSO switches on a new 100MW feeder, what will happen to the system?



Hydro droop 2%: 1Hz change in frequency = 25MW change in output
Steam droop 4%: 2Hz change in frequency =1,000MW change in output

Assume that the frequency drop by 0.4Hz when 100MW feeder is switched on
For the hydro unit a change of -0.4Hz mean a change of +5MW but the load limiter will limit the output of generator to 25MW

For the steam unit, a change of -0.4Hz will result in a change of +400MW but as the output of the generator increases, the frequency will increase towards 50Hz, this reduces the frequency difference and thus reduce the increase in output of the generator.

Most likely the system frequency will settle around 49.85Hz and the output of hydro around 23MW and that of steam around 625MW. Some load is loss due to frequency dependent load.

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Grid System Is Very Complex and Interactive

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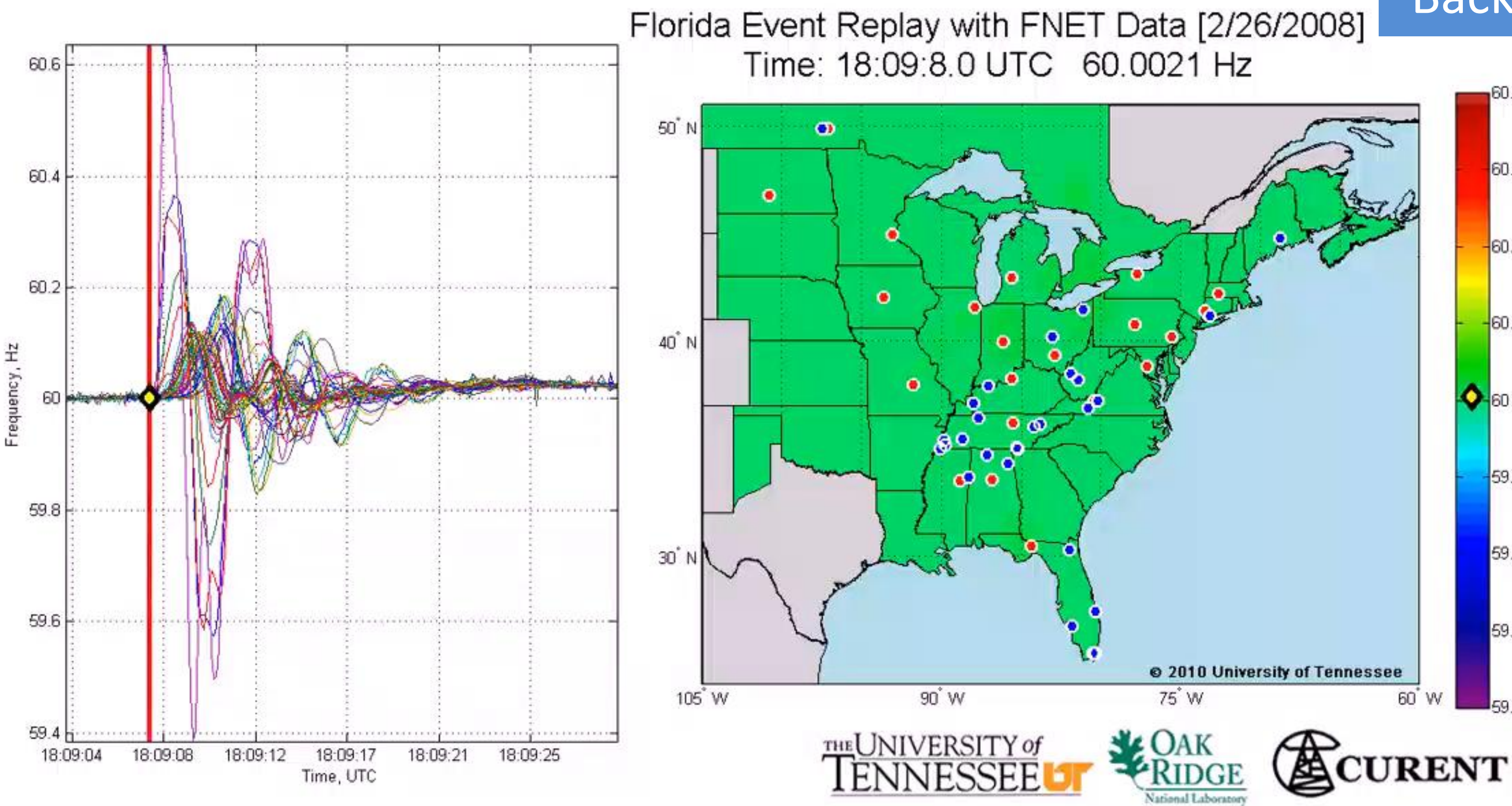

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