OPERATION , SCHEDULING AND DISPATCH CODES

By :

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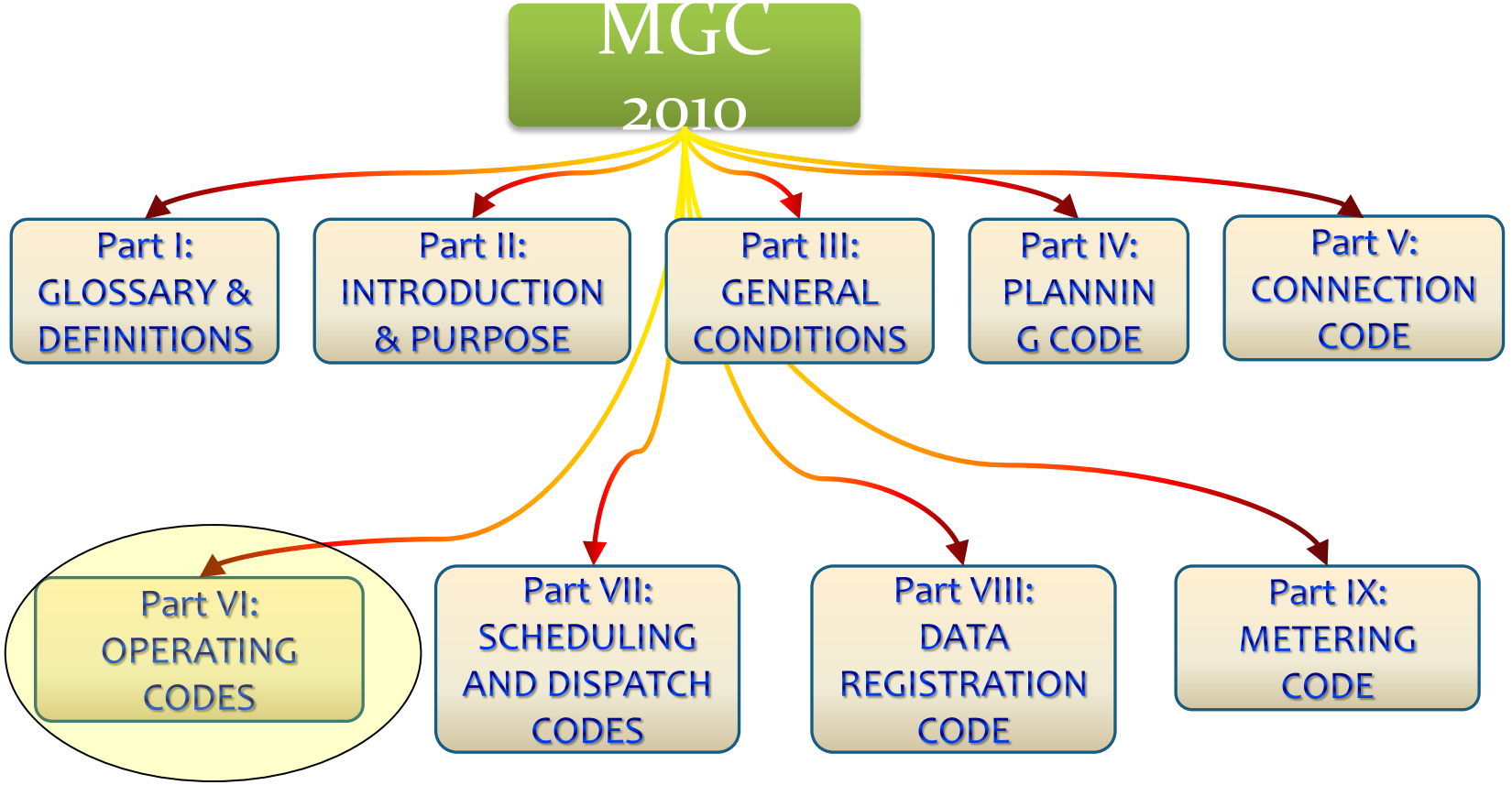
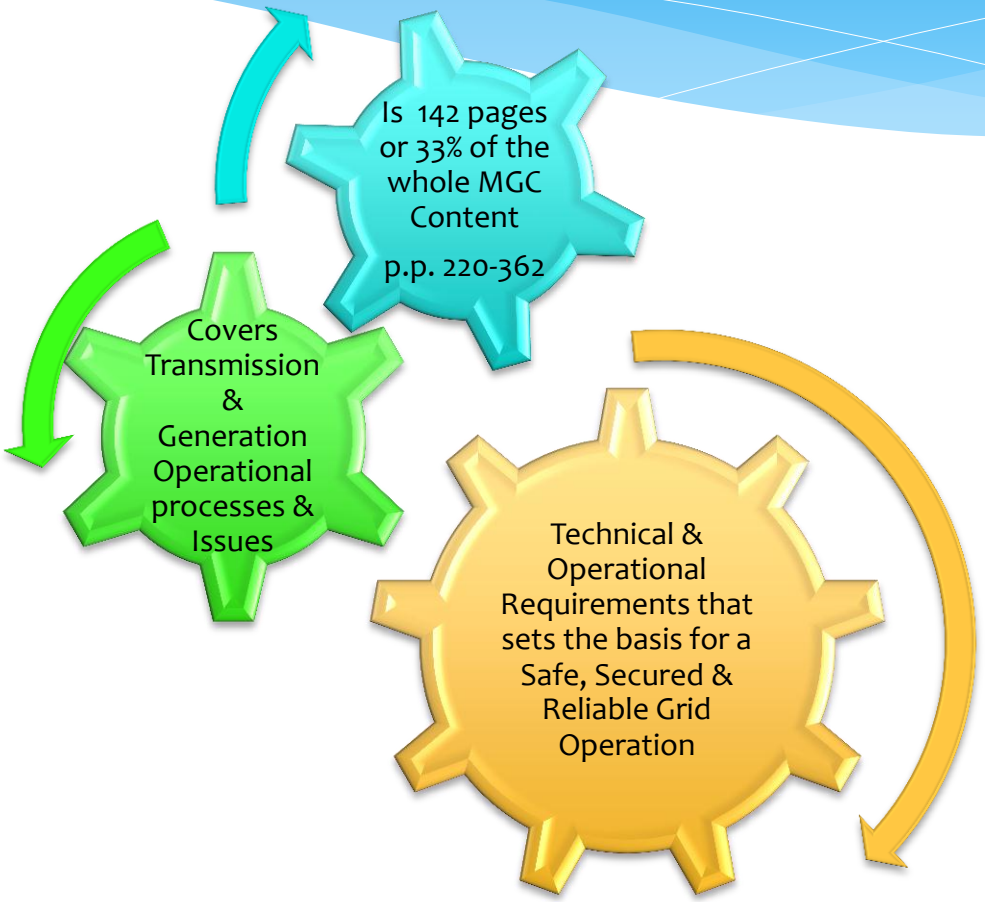
The Malaysian Grid Code Awareness Programme Funded by
Akaun Amanah Industri Bekalan Elektrik (AAIBE)

RECAP on MGC


MGC 2010
Part I: GLOSSARY & DEFINITIONS
Part II: INTRODUCTION & PURPOSE
Part III: GENERAL CONDITIONS
Part IV: PLANNIN G CODE
Part V: CONNECTION CODE
Part VI: OPERATING CODES
Part VII: SCHEDULING AND DISPATCH CODES
Part VIII: DATA REGISTRATION CODE
Part IX: METERING CODE

General Facts about Operation, Scheduling and Dispatch Codes



OPERATION CODES

- OC1 : Demand Forecast
- OC2 : Outage & Related Planning
- OC3 : Operating Reserve & Respond
- OC4 : Demand Control
- OC5 : Operational Liaison
- OC6 : Significant Event Reporting
- OC7 : Emergency Operation
- OC8 : Safety Coordination
- OC9 : Numbering & Nomenclature
- OC10 : Emergency Operation
- OC11 : Safety Coordination

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

KeTTHA KEMENTERIAN TENAGA, TEKNOLOGI HIJAU DAN AIR

OC1 : Demand Forecast

- Enable matching of Generation and Demand in operation
- Ensure the provision of data to the GSO by Users for operation purposes
- Provide for the factors to be taken into account by the GSO when Demand forecasting is conducted in operation

Who is Involved

- All Generators with Centrally Dispatched Generating Units
- All Generators with Generating Units not subject to Dispatch by the GSO with total on site generation capacity equal to or above 30MW and where the GSO considers it necessary
- Directly Connected Customers where the GSO considers it necessary
- Network Operators
- Distributors
- Directly Connected Customers who have agreed to participate in Demand control
- Interconnected Parties

Demand Forecasting Periods

Operational Planning Phase	• 5-Year ahead forecast – hourly (based on Grid Owner's plan) • 1-Month ahead forecast – hourly • 10-Day ahead forecast – half hourly • 1-Day ahead forecast – half hourly
Operation Control Phase (Real time operation)	• Hour ahead forecast – half hourly
Post Operational Control Phase	• Phase following real time operation

OC2 : Outage & Related Planning

- Enable the GSO to coordinate generation and transmission outages to achieve economic operation and minimize constraints
- To set out procedure including information required and a typical timetable for the coordination of planned outage requirements for Generator
- To set out procedure including information required and a typical time table for the coordination of planned outage requirements for other Users that will have an effect on the operation of the Grid System
- To establish the responsibility of the GSO to produce an Operational Plan on the Grid System.

Who is Involved

- All Generators with Centrally Dispatched Generating Units
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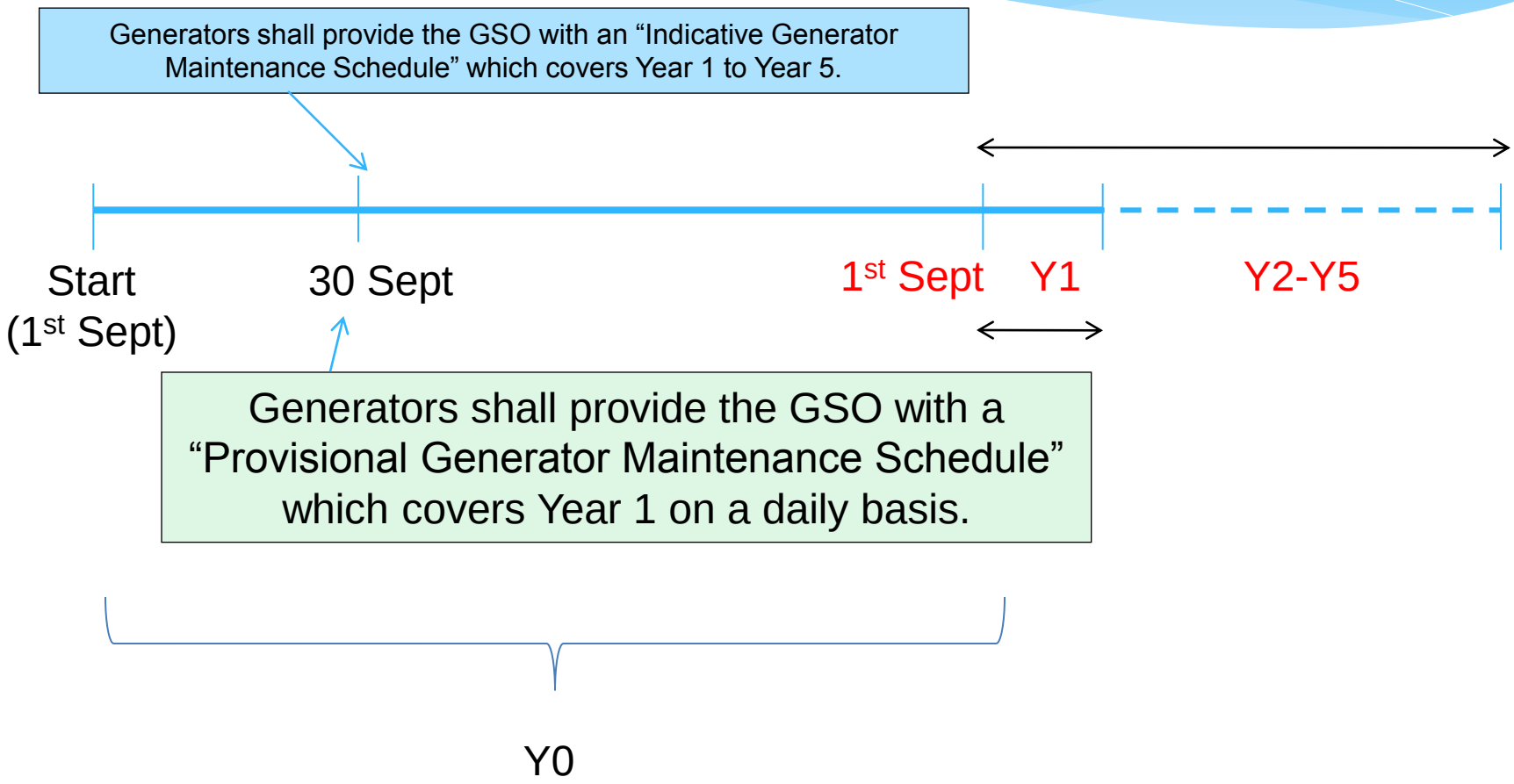
- Interconnected Parties

Transmission Outage Category

Outage Category	Definition
Planned Outage	Outage for the month-ahead that is entered into ICOMS on or before the 10th of the month (outages discussed in monthly coordination meeting)
Unplanned Outage	Outage that is entered into ICOMS after 10th of the month but more than 1 day (outages not discussed in monthly coordination meeting)
Emergency Outage	Outage that is entered into ICOMS 1 day or less before the intended date of outage, which is urgently required to prevent equipment tripping or failure
Forced Outage	Outage that occurred due to an equipment tripping or failure and entered by NLDC into ICOMS

Generator Plan Outage Timeline



Note: Each year starts on the 1st Sept.

OC3 : : Operating Reserve & Respond

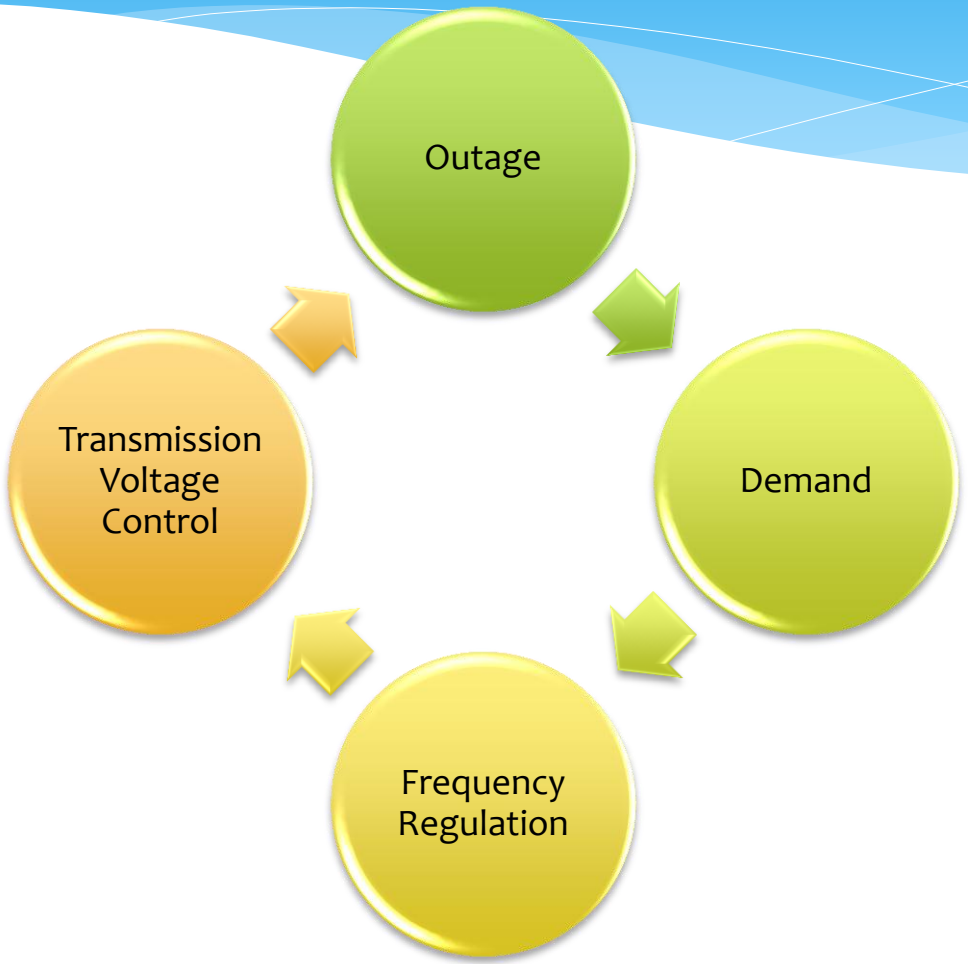
Describe the types of reserves which shall be utilized by the GSO Pursuant to the Scheduling and Dispatch Codes

identify parameters associated with operating reserves typically Required by the GSO

Who is Involved

- Single Buyer
- All Generators with Centrally Dispatched Generating Units
- Directly Connected Customers (Demand Control)
- Network Operators
- Distributors
- Interconnected Parties

Reasons for Operating Reserves



Operating Reserve (OR)

Spinning

Additional Output from *Synchronized* Generating Units

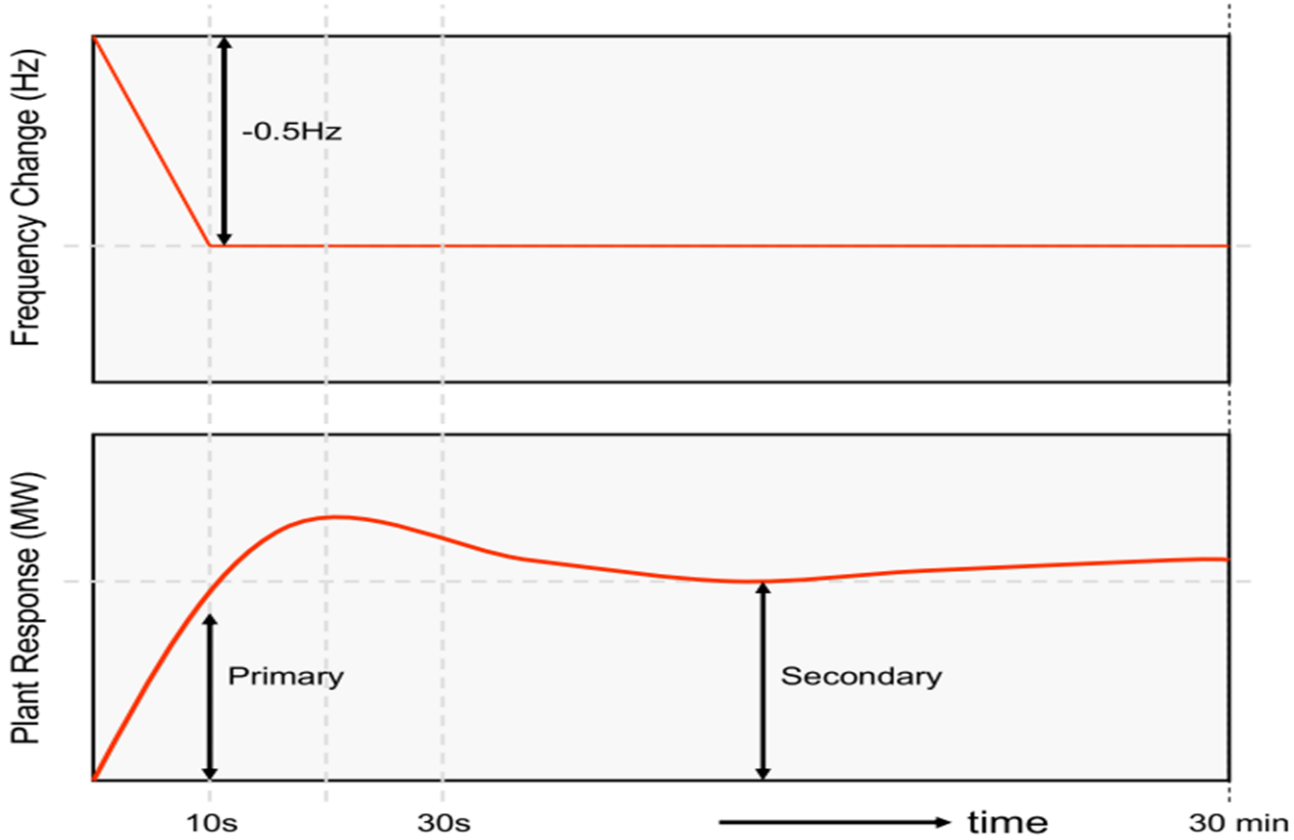
Non Spinning

Output available from *Standby* Generating Units

Operating Reserve

Installed Capacity – (MD + Mw Outage+ Line Constraint)

Primary & Secondary Responses



Required Data by GSO

Primary & Secondary characteristics to Frequency change at different levels of loading

Governor droop and dead band characteristics

CDGU control options for maximum, normal or minimum droop, expressed as a percentage of frequency drop.

OC4 : Demand Control

- Enable the provision of facilities to allow the GSO to achievereductioninDemandontheGridSystem,inwholeorinpart
- enabletheGSOtoinstructDemandControlinamannerthatdoesnot unduly discriminate against, or unduly prefer, anyone or anygroupofUsers
- EnsurethattheGSOisnotifiedofanyDemandControlutilisedbyUsersother than following an instruction from thanGSO

Why Demand Control ?

Demand Control shall include but not limited to

- Automatic load/demand shedding
- Manual load/demand shedding
- Reduction of load through voltage reduction

To be used by the GSO in order to prevent

- Frequency excursions
- System thermal overloads
- System voltage collapse

Applies to...

- All Generators with Centrally Dispatched Generating Units
- Directly Connected Customers
- Grid Owners
- Distributors
- Network Operators
- Single Buyers

OC5 : Operational Liaison

To provide for the exchange of information that is needed in order that possible risks arising from the Operations and or Events on the Grid System and or User Systems can be assessed and appropriate action taken

Detail communication facilities required between the GSO and each category of User

provide a framework for information flow and discussion for Commissioning Tests and Compliance tests

To detail the general procedures that will be established to authorize personnel who will initiate or carry out operations on the User System

Who is Involved

- All Generators with Centrally Dispatched Generating Units
- Grid Owner
- Directly Connected Customers where the GSO considers it necessary
- Network Operators
- Distributors
- Interconnected Parties

Roles of GSO System Warnings

- Alert Users to possible Grid System problems and/or Demand Reductions
- Inform of the applicable period;
- Indicate intended consequences for Users
- Enable specified Users to be in a state of readiness to react properly to instructions received from GSO.

Types of GSO System Warnings

GSO System Warnings include warnings related to the conditions of the Grid Systems as well as the color coded warnings associated with Demand Controls as specified in OC4.4.

System Warnings related to the conditions of the system are:

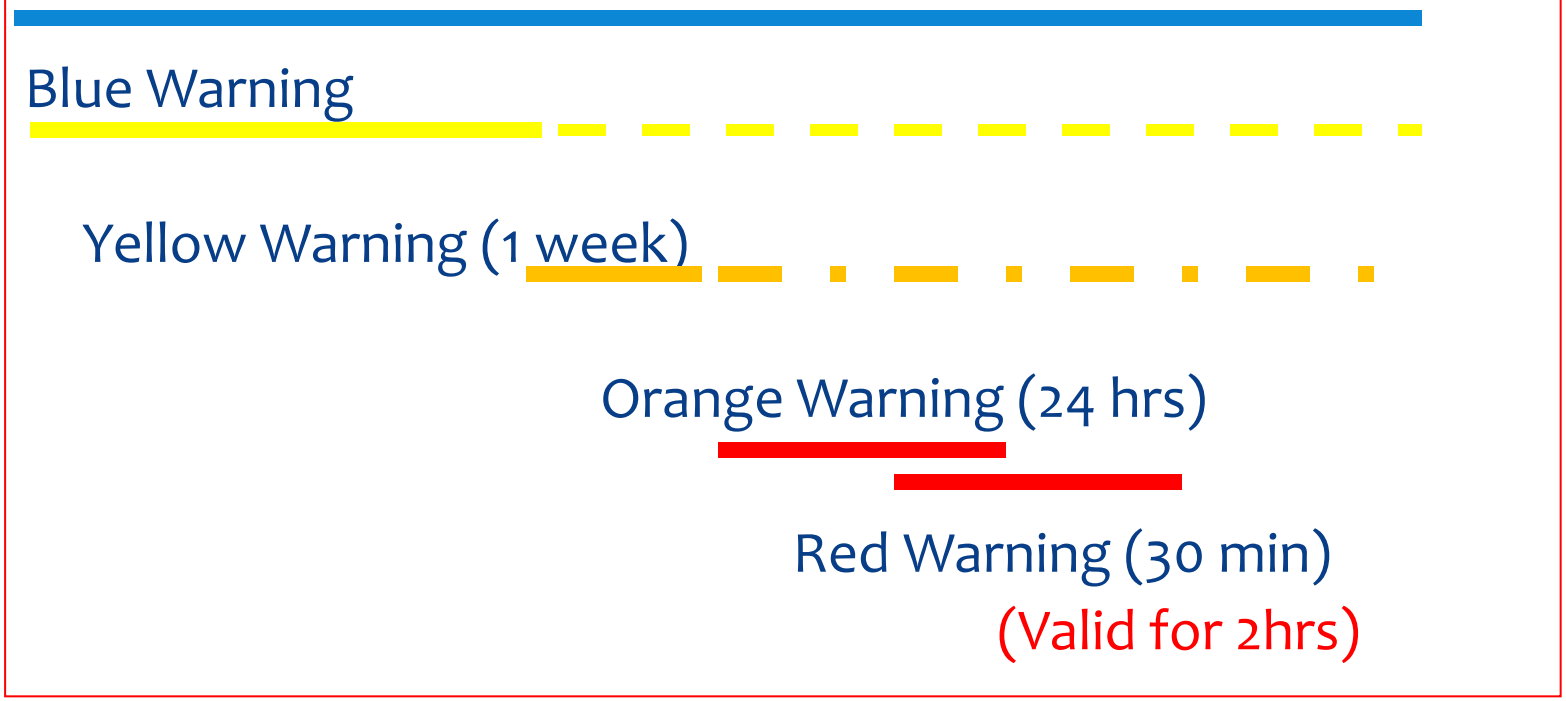
- (1) Blue Warning - Inadequate System Margin
- (2) Brown Warning - Risk of System Disturbance

System Warnings related to Demand Controls are:

- (1) Yellow Warning - Probable Risk of Demand Reduction; (1 week)
- (2) Orange Warning - High Risk of Demand Reduction (24hrs)
- (3) Red Warning - Extremely High Risk of Demand Reduction or
- Demand Control Imminent (30min)

The above warnings are specified in OC4.4.

Types of GSO System Warnings - OC5.8.4



Demand Control

Methods of achieving Demand Reduction
(a) Customer Demand Management initiated by Users;
(b) Customer voltage reduction initiated by Users
(c) Customer Demand reduction by Disconnection initiated by users
(d) Customer Demand reduction instructed by the GSO;
(e) automatic low Frequency Demand Disconnection;
(f) emergency manual Demand Disconnection.
(g) Automatic low voltage demand disconnection
(h) Automatic demand disconnection through intertripping.

OC6 : Significant Incident Reporting

The objective is to facilitate the provision of detailed information in reporting Significant Incidents.

Who is Involved

- All Generators with Centrally Dispatched Generating Units
- All Generators with Generating Units not subject to Dispatch by the GSO with total on site generation capacity equal to or above 30MW and where the GSO considers it necessary
- Directly Connected Customers where the GSO considers it necessary
- Network Operators
- Distributors
- Directly Connected Customers who have agreed to participate in Demand control
- Interconnected Parties & Single Buyer

SIGNIFICANT INCIDENT REPORTING

* Significant Incidents :
  * Abnormal operation of plant.
  * Voltage outside normal operating condition limits
  * Frequency
  * System instability

* If the Significant Incident occurred on the Grid System, the GSO will submit a preliminary report to the Energy Commission within 3 Business Days of the Significant Incident and the final report within two 2 calendar months

OC7: Emergency Operations

To ensure that in the event of Grid System Emergencies normal supplies are restored to all consumers as quickly and as safely as practicable in accordance with Prudent Utility Practice

To outline the general contingency and restoration strategies which shall be adopted by the GSO

To initiate the communication procedures specified in the OC5, between the GSO and relevant users when system emergency is anticipated to occur or when a critical incident is imminent or has occurred.

Who is Involved

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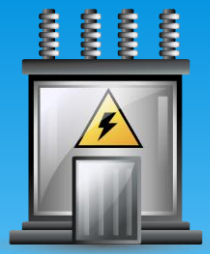
- All Generators with Generating Units not subject to Dispatch by the GSO with total on site generation capacity equal to or above 30MW and where the GSO considers it necessary
- Directly Connected Customers where the GSO considers it necessary
- Network Operators
- Distributors
- Directly Connected Customers who have agreed to participate in Demand control
- Interconnected Parties & Single Buyer

Emergency Situations



- A total blackout or partial blackout
- Imminent occurrence of disruption of supply;
- The separation into one or more Power Islands of the Grid System with associated loss of synch due to the activation of an automatic de-coupling scheme or the unexpected tripping of parts of the Grid System
- Voltage collapse of part of the Grid System;
- The loss of a strategic transmission group due to adverse weather condition, environment emergencies including haze, sabotage etc.;
- Fuel supply emergency
- Loss of the NLDC.

OC7.4.9 Fuel Supply Emergency

Clause	Requirement
OC7.4.9.2	The Single Buyer and GSO shall report the adequacy of the fuel supply inventory to the EC on an exception basis. In the event of any fuel supply shortages this reporting will be on a daily basis. Under these conditions the Single Buyer and the **GSO shall abandon the Least Cost Generation Scheduling and revert to a Fuel Availability Based Scheduling** conserving fuel supplies and taking all necessary measures to extend the endurance of the fuel supplies.
OC7.4.9.3	In the event the Single Buyer or GSO foresees an imminent or possible fuel shortage or curtailment of supplies the Single Buyer or GSO shall also instruct Generators to increase their fuel stock to the full extent of their capacity available at the Power Station to ensure continued endurance

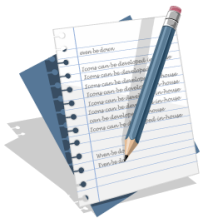
OC8: Safety Coordination

Establish the requirement on the GSO and users (or their contractors) to carry out work on the grid system or user system respectively in accordance with approved safety regulations

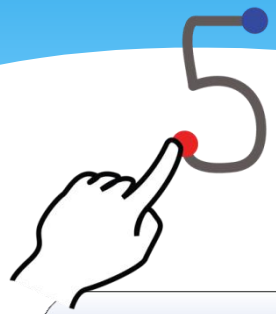
Ensure safe working conditions for personnel working on or in close proximity to plant and apparatus on the grid system or personnel who may have to work at or use the equipment at the interface between the grid system and a user system

OC 8.4.4 Record of Inter-System Safety Precautions (RISP)

Clause	Requirement
OC8.4.4.2	The GSO will use the format of the RISP forms set out in appendix 1 and appendix 2 to this OC8. That set out in appendix 1 and designated as "RISP-R", shall be used when the GSO is the Requesting Safety Coordinator, and that in appendix 2 and designated as "RISP-I", shall be used when the GSO is the Implementing Safety Coordinator. Proforma of RISP-R and RISP-I will be provided for use by staff of the GSO
OC8.4.4.3	Users shall adopt the format of the GSO RISP forms set out in appendix 1 and appendix 2 to this OC8.



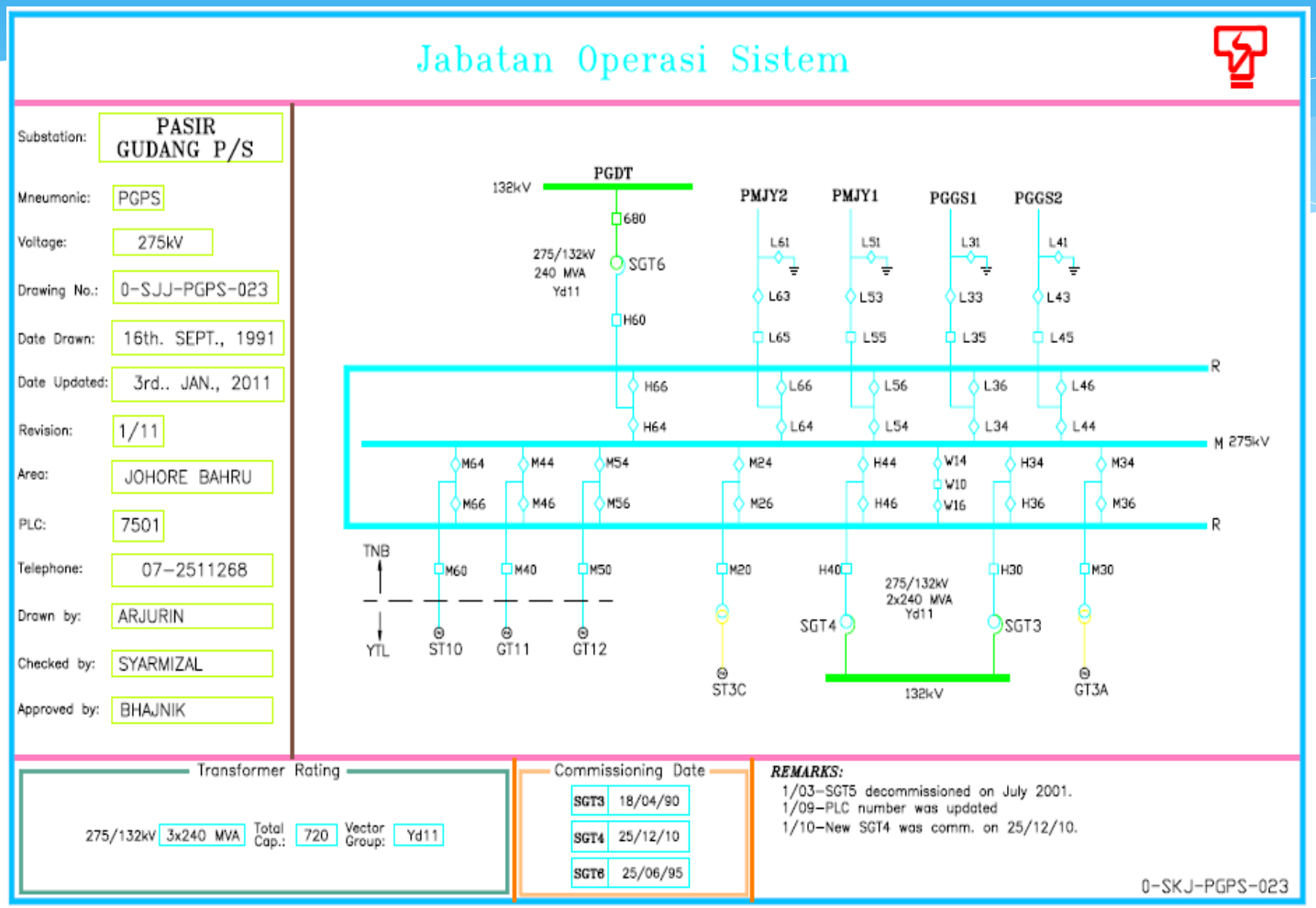
OC9: Numbering & Nomenclature



To provide consistent numbering and nomenclature for apparatus in the Grid System

toensure,sofaraspossible,thesafeandeffectiveoperationoftheGrid System and to reduce the risk of human error faults by requiring, that the numbering and nomenclature of User's HV Apparatus at Grid Supply Points shall be in accordance with thesystemusedbytheGSOasspecifiedinthisOC9

OC9: Typical SLD



Who is Involved

- All Generators
- Grid Owners
- Directly Connected Customers
- Network Operators
- Distributors

OC10: Testing & Monitoring

To enable the GSO and the Single Buyer to carry out, facilitate and coordinate testing and or monitoring the Transmission System or User's System at the Grid Supply Point to ensure compliance;

To establish whether Users comply with the Connection Code

To establish whether CDGUs operate within their Generating Unit Scheduling and Dispatch parameters registered under SDC1 and other relevant Agreement;

To establish whether a CDGU is available as declared

To establish whether Generators can provide those Supplementary Services which they are either required or have agreed to provide under relevant Agreement.

Who is Involved

- All Generators
- Grid Owners
- Directly Connected Customers
- Network Operators
- Distributors

OC11: System Test

To ensure that the procedures for arranging, facilitating and carrying out System Tests do not, so far as is practicable, threaten the safety of personnel or members of the public and minimize the possibility of damage to Plant and or Apparatus and/or the security of the Grid System

Set out procedures preparing and carrying outs System Tests

Set out procedures for reporting of System Tests.

Who is Involved

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- Directly Connected Customers where the GSO considers it necessary
- Network Operators
- Distributors
- Directly Connected Customers who have agreed to participate in Demand control
- Interconnected Parties & Single Buyer

SCHEDULING & DISPATCH CODES

SDC1: GENERATION SCHEDULING

SDC2: CONTROL, SCHEDULING & DISPATCH

SDC3: FREQUENCY AND INTERCONNECTION TRANSFER CONTROL

SDC1: Generation Scheduling

* Scheduling the operations of Generating Units is a major component of operations plans.

* Scheduling of the Generating Units depends upon the pattern of demand by the system, the Least Cost operation of Grid System, the availability, parameters and costs of Generating Units, the flexibility of operation of Generating Units, constraints on the Transmission System, security requirements, and System losses.

Who is Involved

- All Generators with Centrally Dispatched Generating Units
- Grid Owner
- Directly Connected Customers where the GSO considers it necessary
- Network Operators
- Distributors
- Directly Connected Customers who can provide Demand Reduction in real time
- Interconnected Parties

SDC1: Generation Scheduling

* To enable Single Buyer to prepare a schedule based on the Least Cost Dispatch model.
* Models variable costs, price data, fuel price data, heat rate data, gas volume and pressure constraints, other fuel constraint, reservoir lake level, and riparian requirement, and allows hydro/thermal optimization.
* Used in the SDC process and thereby:
    1. Ensures integrity of the Interconnected System and security of Supply
    2. Ensures sufficient gen Capacity to meet demand with appropriate margin of reserve
    3. Enables preparation and issuance of a Generation Schedule
    4. Enables optimization of total cost of Grid operation
    5. Optimization of generating and transmission capacities
    6. Maintains sufficient solid & liquid fuel stocks, optimises hydro reservoir depletion and meet fuel-contract requirement

Least Cost Operation

* A least cost generation schedule will be complied by the Single Buyer on Day Ahead Basis with the following consideration:
  I. Generator energy pricing information
  II. Hydro/thermal optimization
  III. Any operational restrictions or Generators operational inflexibility
  IV. Gas volume and pressure constraints, and other fuel constraints
  V. Minimum and maximum water-take for hydro Generators and other associated factors with water usage or conservation
  VI. Export or import of Energy across the Interconnectors
  VII. Requirements by the State or Federal Gov. to conserve certain fuels
  VIII. The Availability of Generators as declared in the Availability Declaration
  IX. In cases where fuel prices are subsidized, the price used for scheduling shall be the price set by the Government
* Single Buyer shall prepare a least cost Unconstrained Schedule and a least cost Constrained Schedule

SDC2: Control, Scheduling & Dispatch

* This procedure is for the issue of Dispatch instructions to Generators,confirmation,approvalandexecutionoftransferswith Interconnected Parties, by the GSO, utilizing the Least Cost Generation ScheduledderivedfromSDC1,aspreparedbytheGSO,with an appropriate margin of reserve, whilst maintaining the integrity of the Transmission System together with the necessary security of supply.

* It also provides the procedure to carry out a re+optimising of theGenerationScheduleasmayberequiredinthereasonableopinionof the GSO in real time.

Who is Involved

- All Generators with Centrally Dispatched Generating Units
- Grid Owner
- Directly Connected Customers where the GSO considers it necessary
- Network Operators
- Distributors
- Directly Connected Customers who can provide Demand Reduction in real time
- Interconnected Parties

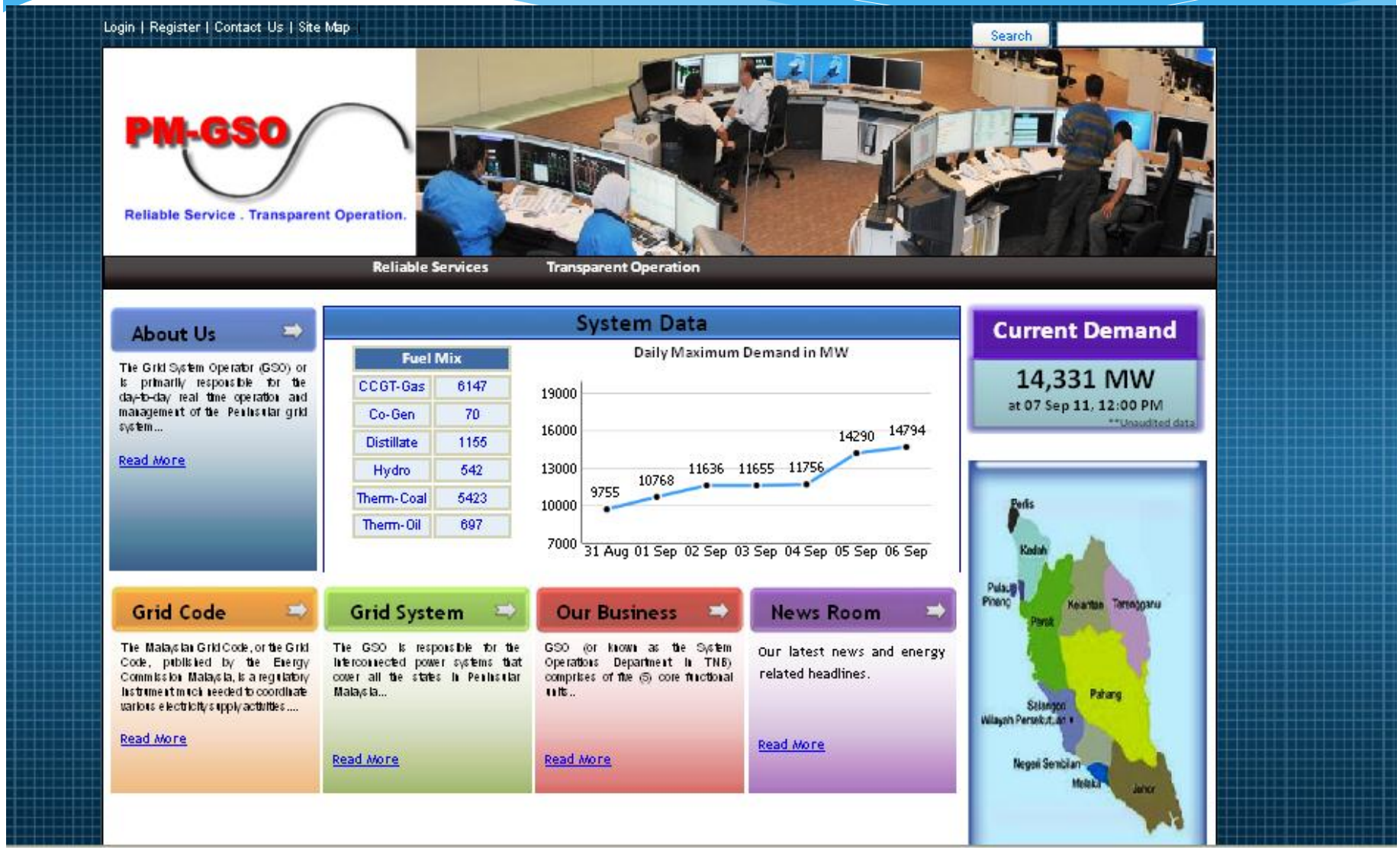
SDC3: Frequency & Interconnector Transfer Control

* The procedure for the GSO to direct System Frequency Control and is intended to enable (as far as possible) the GSO to meet the statutory requirements of System Frequency Control, and to manage tie line control in accordance with relevant Agreements with Interconnected Parties.
* .

GSO WEBSITE
(to download MGC Document)

•The Web Site can be accessed via http://129.15.10.201/ (TNB Intranet) or http://gso.org.my/ (Outside TNB)

Screenshot of GSO Website



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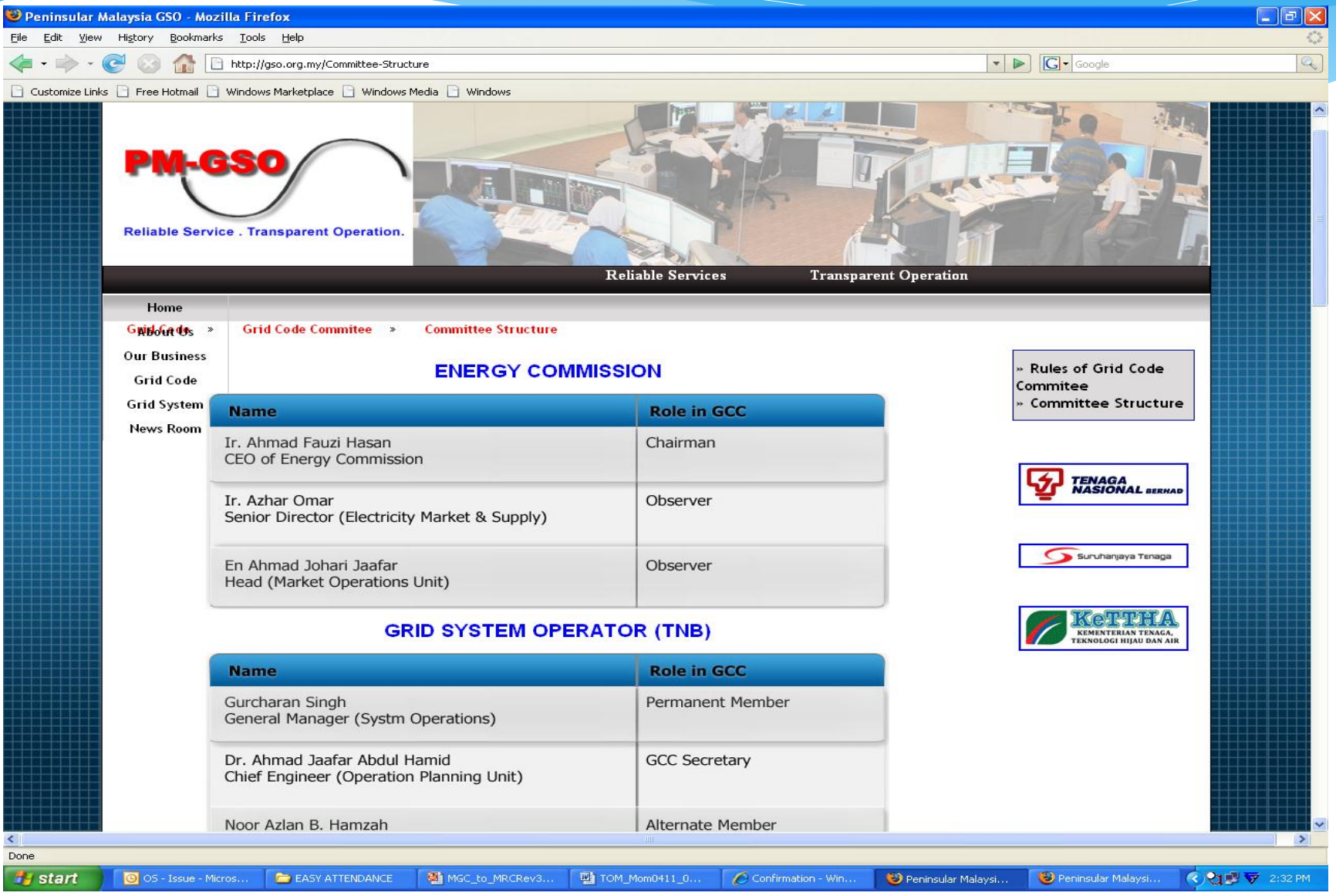

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