MESYUARAT PANEL PERUNDINGAN TENAGA

By
Mr. Gurcharan Singh
Head (GSO)

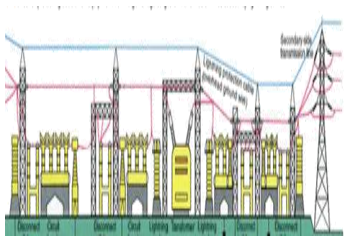
10th JUNE 2014

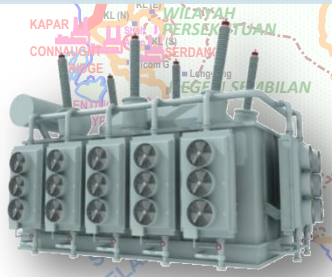
TENAGA NASIONAL BERHAD

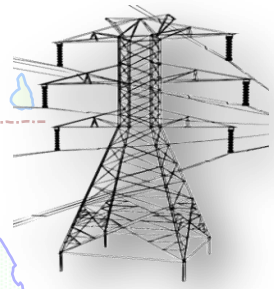
OVERVIEW

SYSTEM HIGHLIGHTS

GENERATION INSTALLED CAPACITY	• 21,509 MW
TNB	• 11,222 MW (52.2%)
IPP	• 10,287 MW (47.8%)
MAXIMUM DEMAND (29/05/14)	• 16,583 MW
RESERVE CAPACITY MARGIN	• 4,926 MW (29.7%)
HIGHEST ENERGY DEMAND (25/6/2013)	• 345.25 GWH/DAY







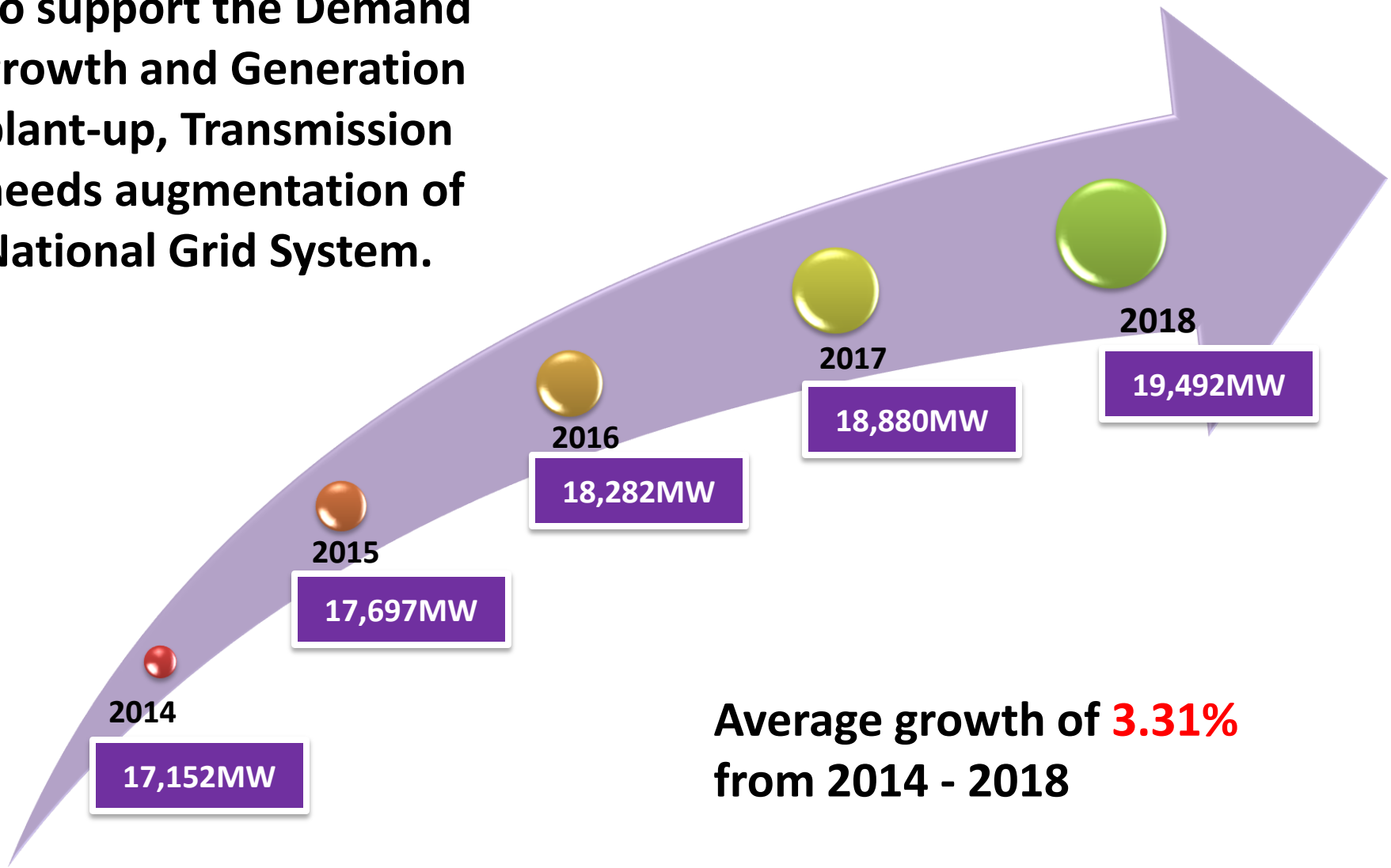
404
SUBSTATION

95,990
MVA INSTALLED CAPACITY

21,092
CIRCUIT KILOMETRES

FORECAST DEMAND GROWTH

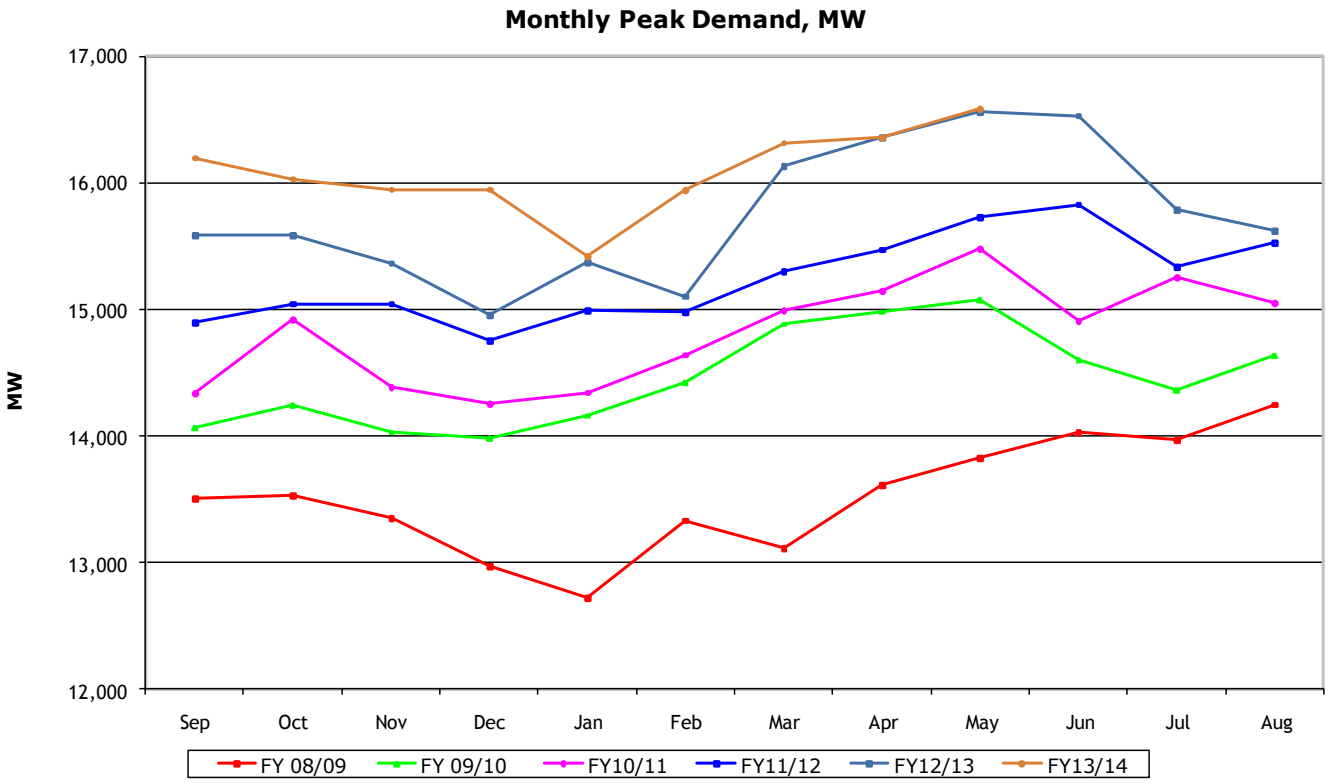
To support the Demand growth and Generation plant-up, Transmission needs augmentation of National Grid System.



Average growth of 3.31% from 2014 - 2018

MONTHLY MAXIMUM DEMAND FY 2008/2009 – FY 2013/2014

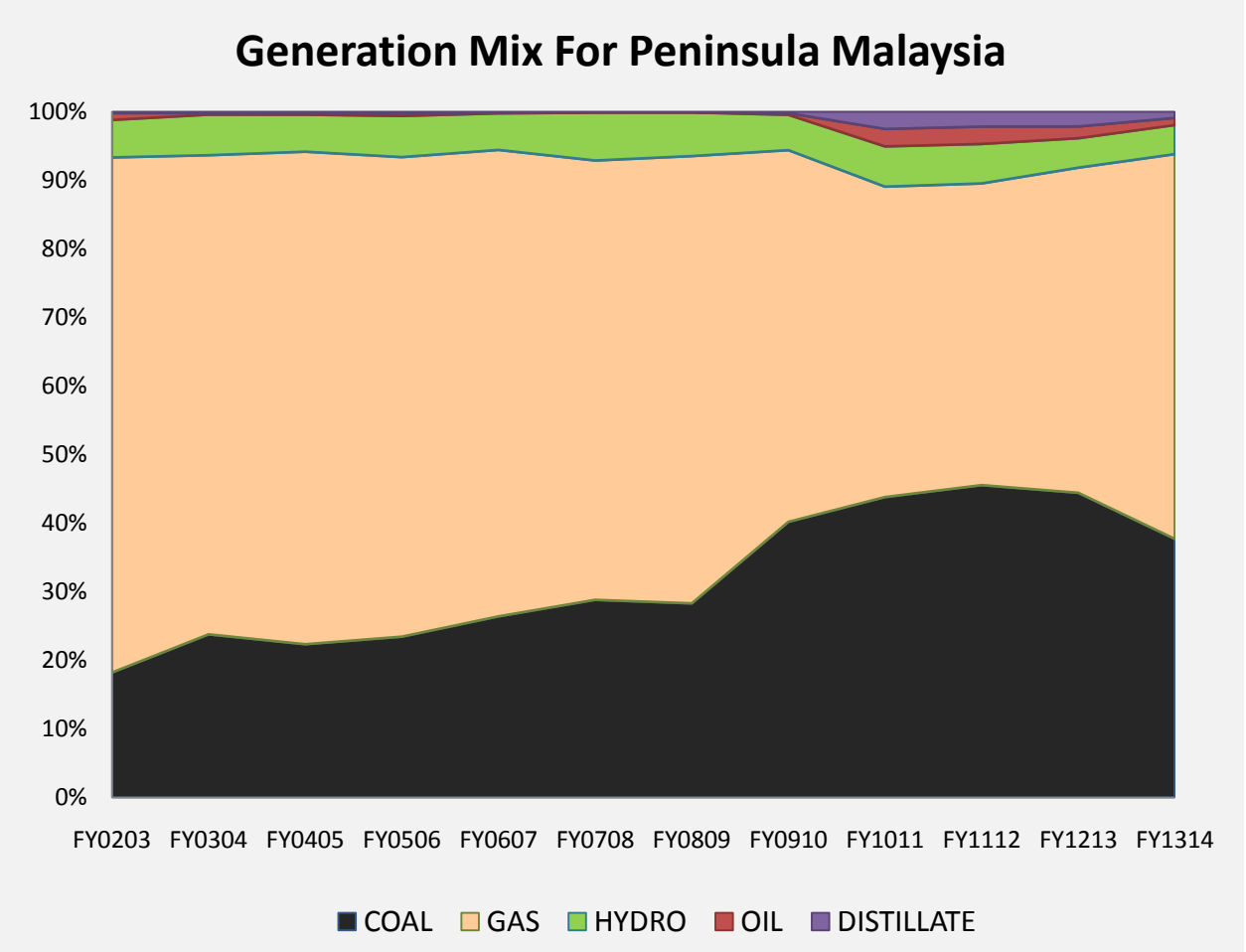
Financial Year	Highest MD (MW)
08/09	14,245
09/10	15,072
10/11	15,476
11/12	15,826
12/13	16,562
13/14	16,583



Maximum Demand for 2014 forecasted to increase during June to August impacted by the El-Nino effect.

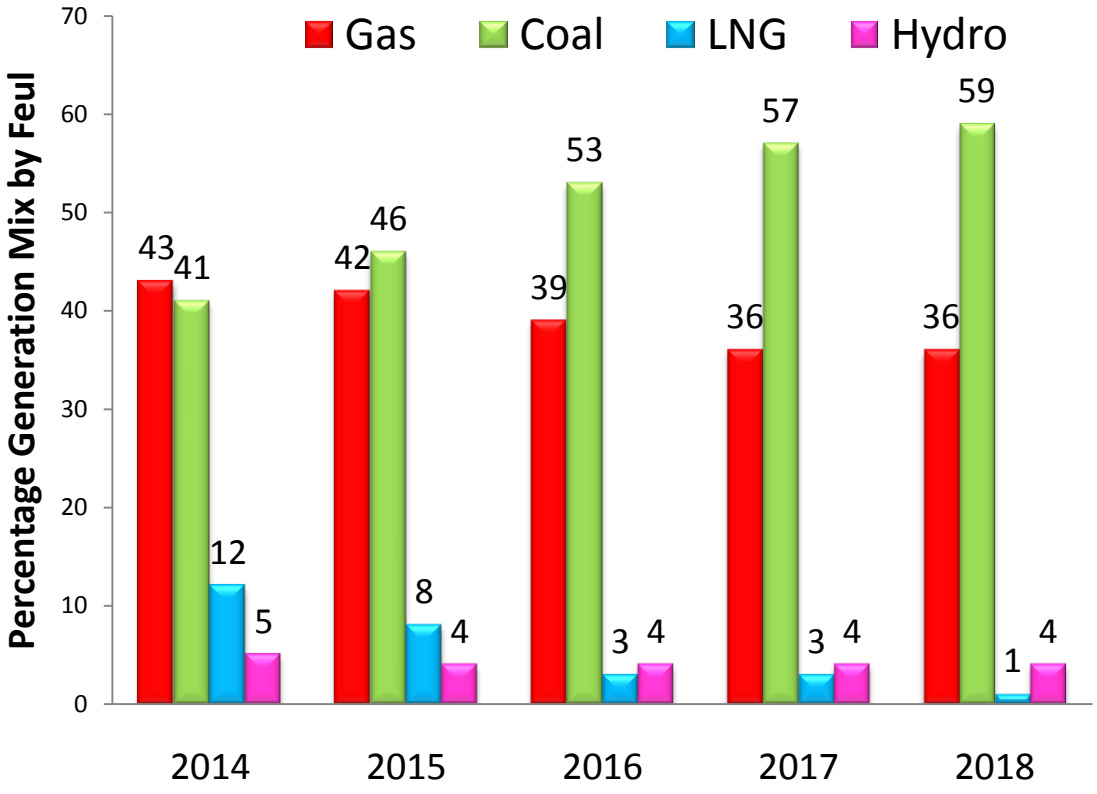
GENERATION MIX 2002-2013

- Major fuel mix in Peninsula Malaysia - Coal and Gas
- Gas dependability reduced from 75% in 2003 to 47% in 2013.
- Coal contributes increased to 45% in 2013.
- For FY1314, coal percentage has dropped due to major rectification work by stations for tube leak problems.
- Oil and Distillate are back up fuels during gas curtailments and coal unit forced outages.



GENERATION MIX BY FUEL 2014-2018

- Future plant-up of coal units pushes Coal to 59% in 2018.
- Gas and LNG kept at 37% and hydro at 4%.
- Coal becomes major fuel mix going forward due to its' competitive pricing and availability readiness.

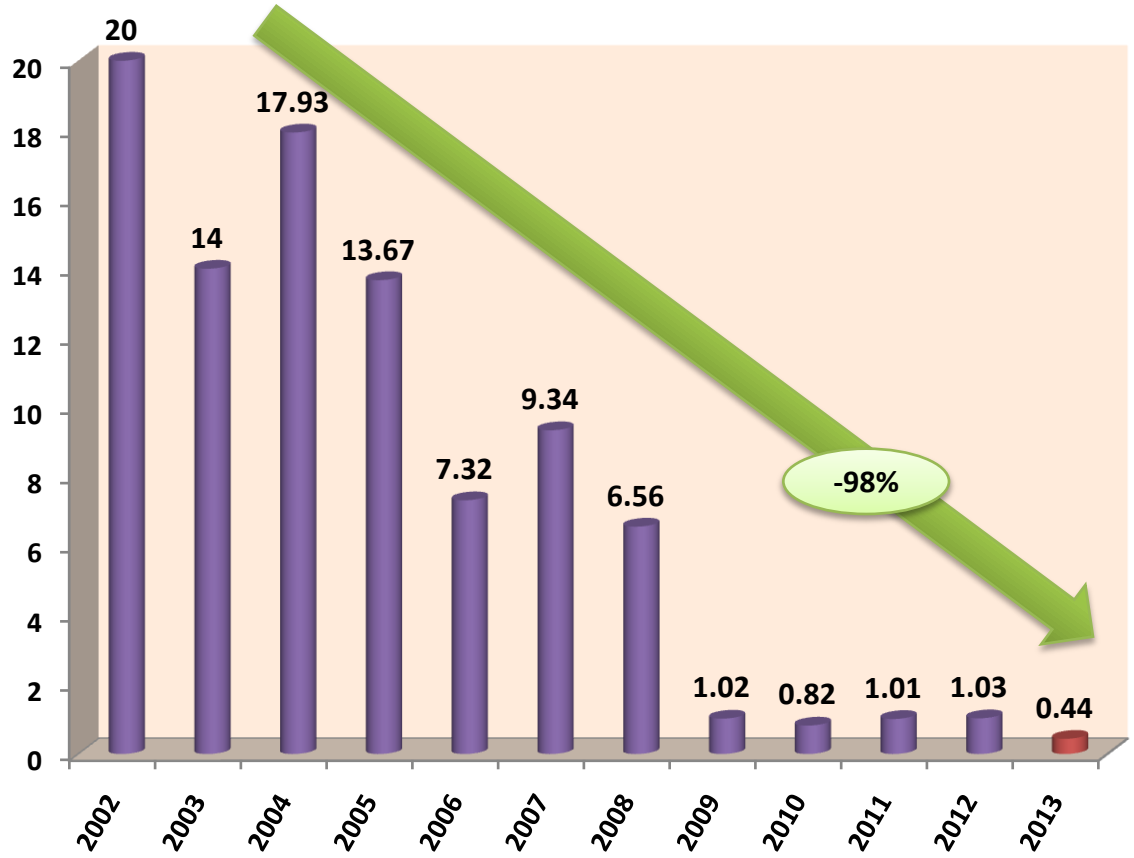


Gas and LNG is differentiated by price and quantum.

- Below 1000mmscfd – GAS (Subsidised price)
- Above 1000mmscfd – LNG (Bintulu price)

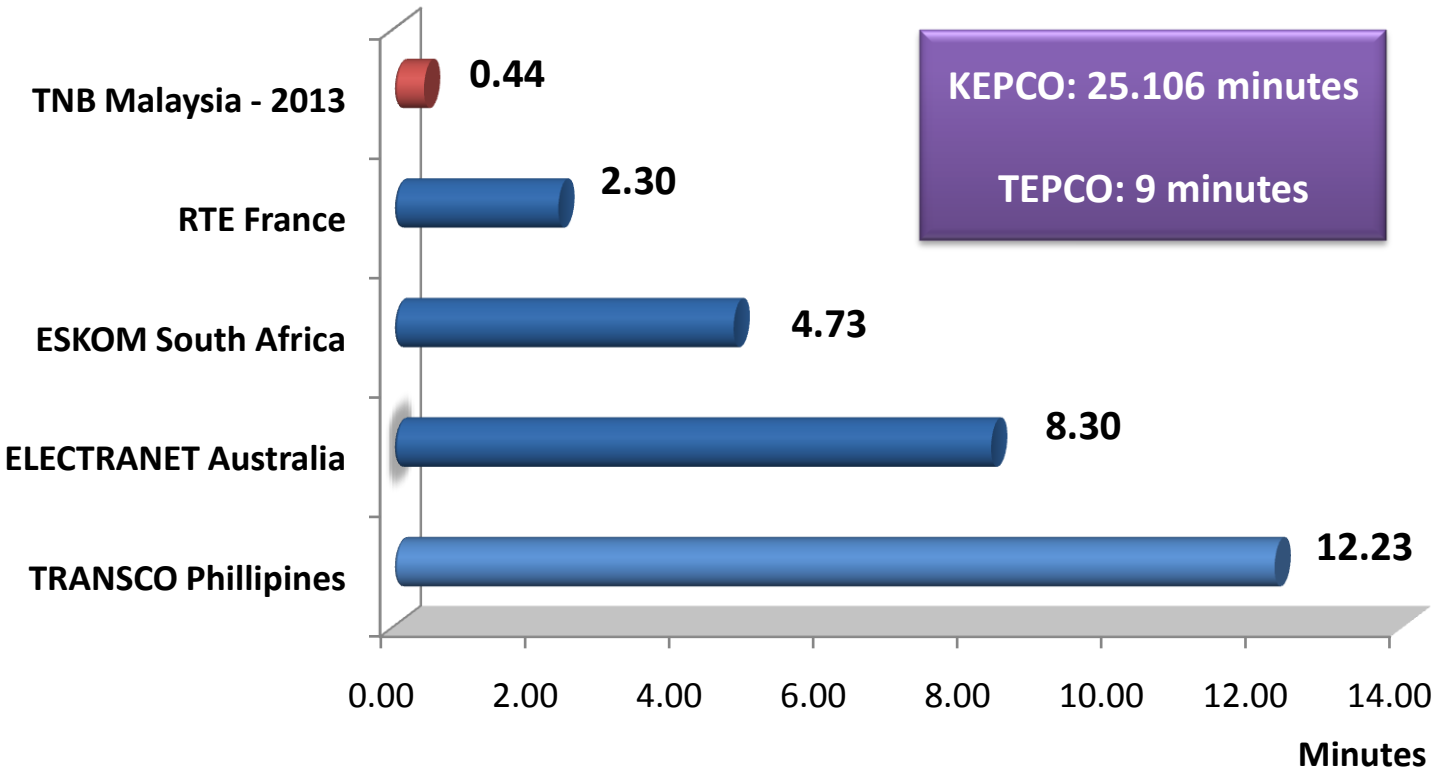
PERFORMANCE - SYSTEM MINUTES

- The international benchmark for system performance and reliability.
- An index that measures the severity of each system disturbance relative to the size of the system.
- Determined by calculating the ratio of unsupplied energy during an outage to the energy that would be supplied during one minute, if the supplied energy was at its peak value.



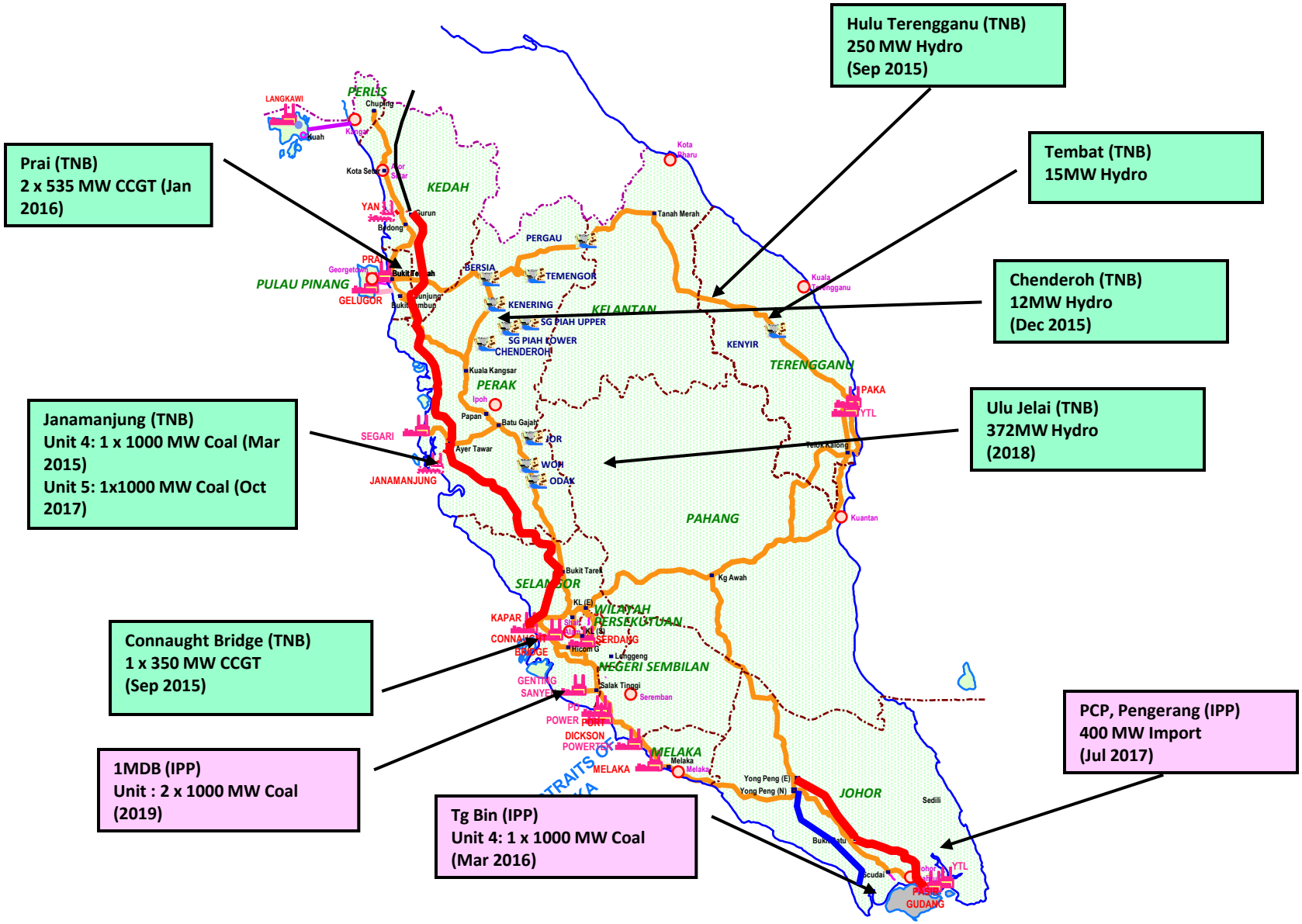
TNB managed to reduce the transmission system minutes from 20min in 2002 to 0.44min in 2013.

SYSTEM MINUTES - BENCHMARKING



For 2013, TNB's performance was better than KEPCO and TEPCO, two major utility in Asia.

ADDITIONAL 7,500 MW GENERATION CAPACITY COMMITTED UNTIL 2019

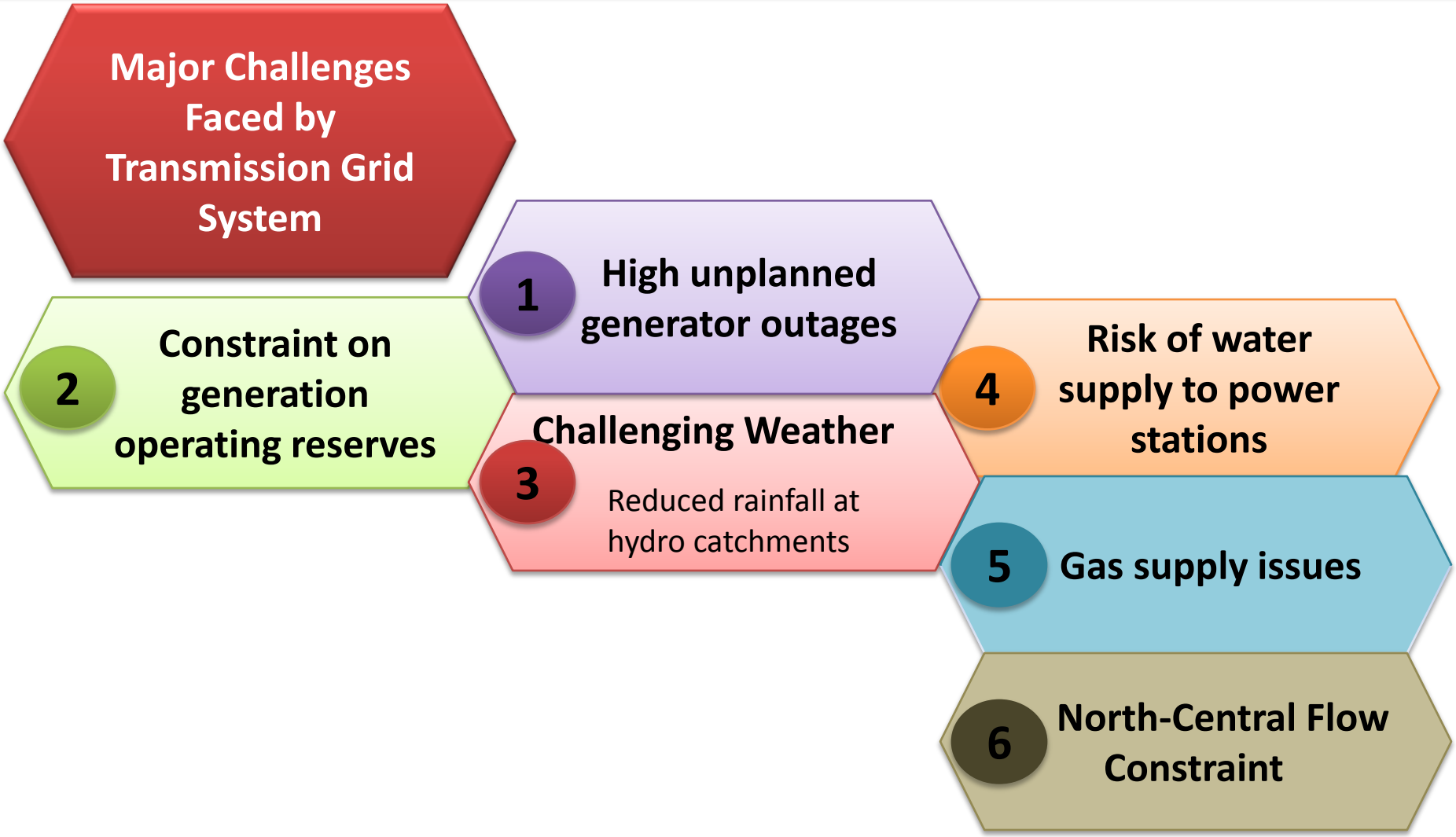


TRANSMISSION PROJECTS REINFORCING THE GRID

- 500KV LINES AYER TAWAR – TAPAH & LENGGENG – YONG PENG(E) (2019)
- ULU JELAI HYDRO (2017)
- TG BIN U4 (2016)
- JANAMANJUNG U4 & U5 (2015)
- PRAI (2016)
- HULU TERENGGANU (2015)

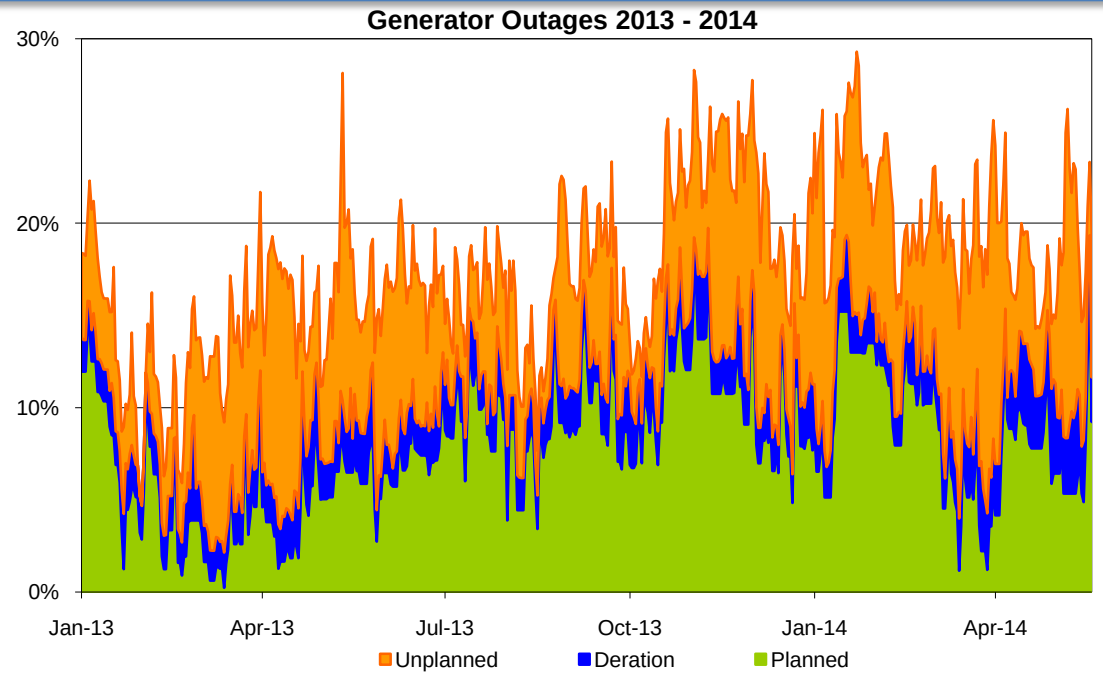
CHALLENGES

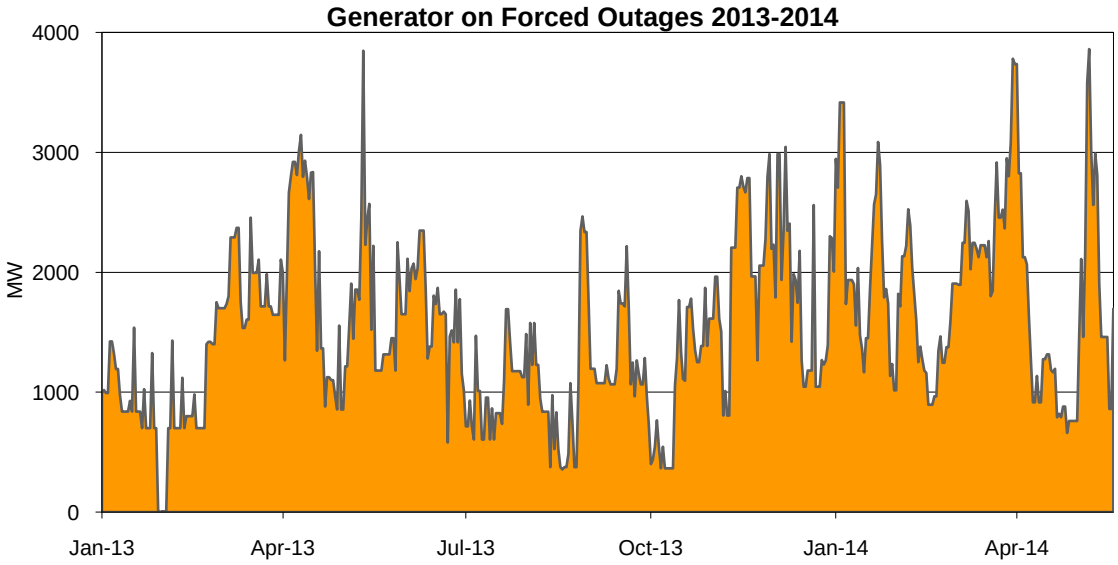
MAJOR CHALLENGES



HIGH UNPLANNED GENERATOR OUTAGES

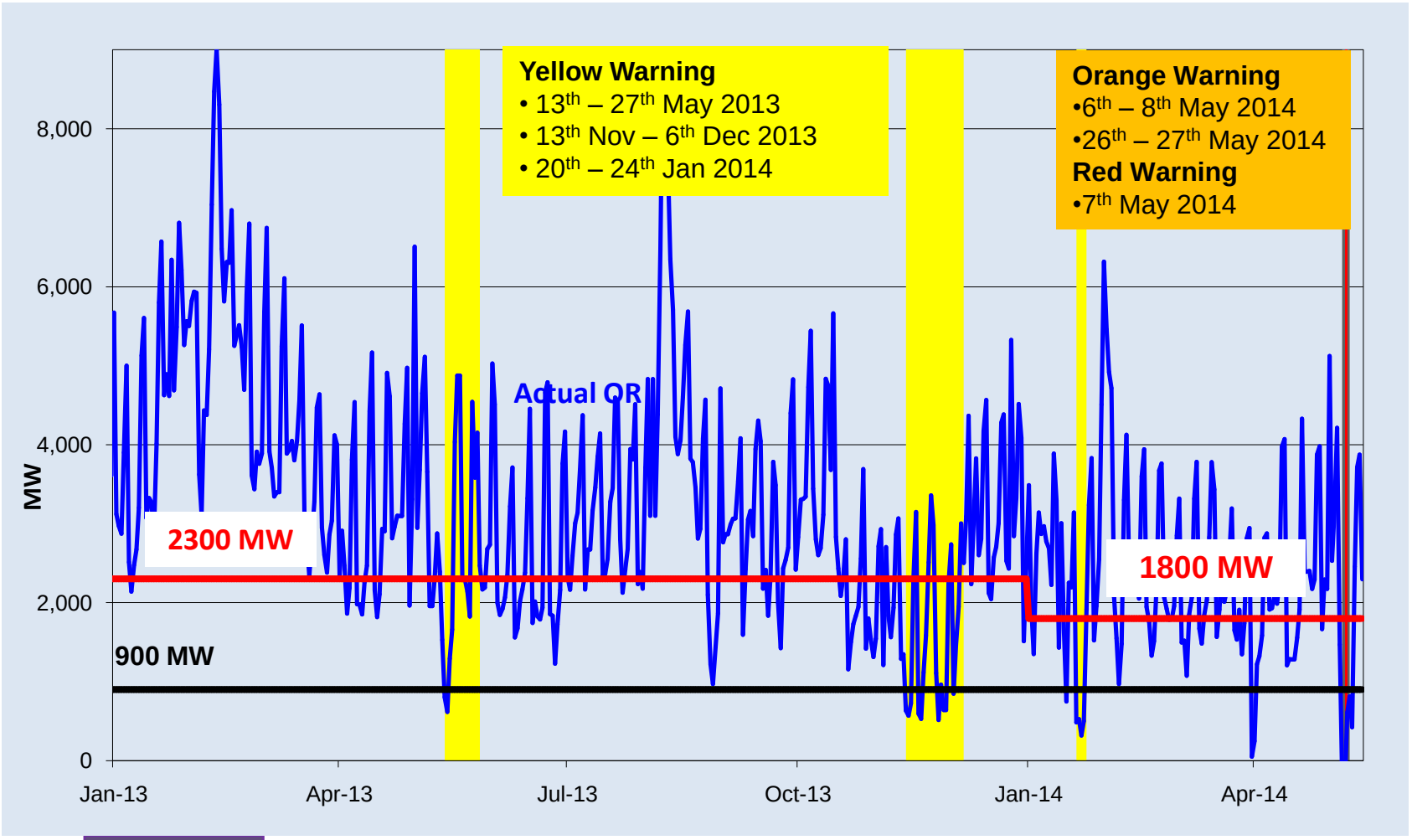
- Total generators outages (plan and forced) averages at 17% for last 2 years.
- Highest outage rate was 29%, on 22 Jan 2014.
- We are operating at 30% reserve margin now.
- Reserve Margin is expected to drop to 25%





- Forced Outage in system can reach up to 3800MW on certain days.

LOW GENERATION OPERATING RESERVE



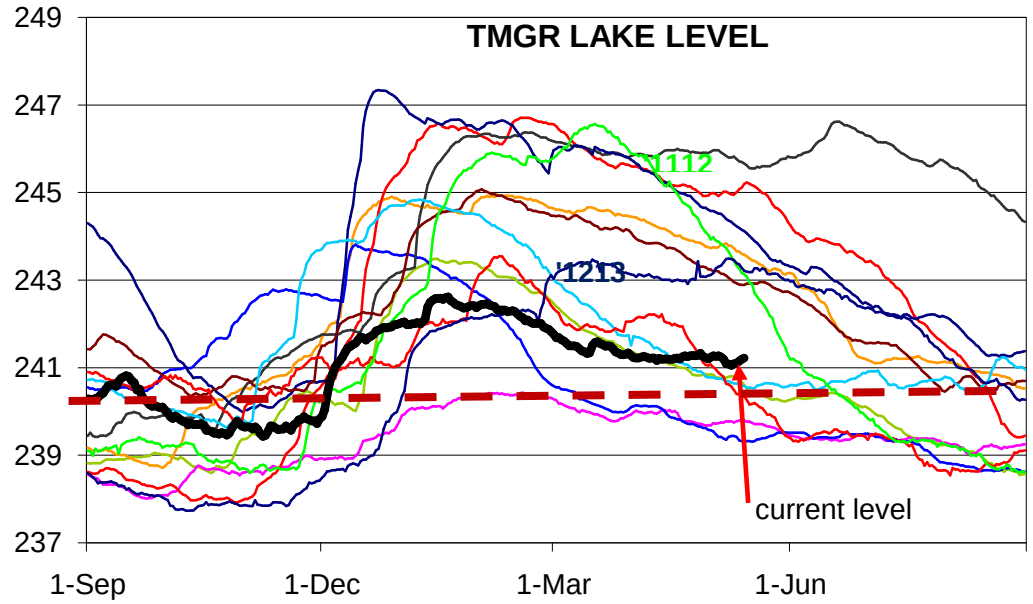
Minimum Operating Reserve

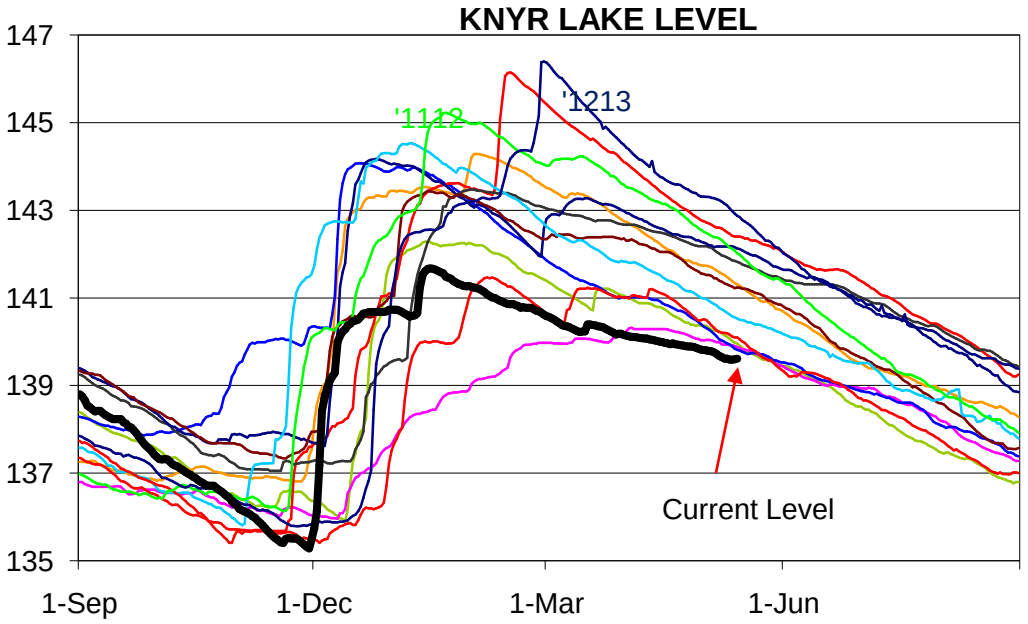
OR target was reduced to 1800MW due to:-

- Demand increase
- To meet schedule outage requirements

CHALLENGING WEATHER

- Current lake level at Kenyir is the lowest for the last 14 years.
- Current water inflow in the catchments area are below average.
- The year end target levels for Kenyir and Temenggor revised due to impounding work for Hulu Trengganu project and the anticipated El-Nino impact.
- Available water resources must be carefully utilized to ensure full capacity throughout the year and 2015.
- Water resources also must be ensured available to meet the relevant agencies minimum discharge requirements.





WATER SUPPLY TO POWER STATIONS

- Raw water supply to power stations are essential for the plant operation.
- All power station are listed as ‘sasaran penting’, thus water supply will be given top priority by water suppliers.
- Station have identified the risk and established mitigation actions if water supply is disrupted.
  - Survival rate, 3 to 10 days.
- High risk states are N. Sembilan and Selangor.
  - Concentration of power stations

GAS SUPPLY

YEAR 2014 MAJOR MAINTENANCE SCHEDULE (6th FEBRUARY 2014)							
No.	Major Facility Shutdown	Shutdown Duration	New SD Duration	Sales Gas Shortfall (MMSCFD)	Allocation to M'sian Power <1250mmscfd	Allocation to M'sian Power (MMSCFD)	Status
1	OSC Tr A shutdown for CF renewal	31 JAN - 9 FEB 2014 (10 days)		300	NO	1000 (Low demand CNY)	COMPLETED
2	Jerneh Rig Mobilisation	11 - 15 MARCH 2014 (5 days)	11 - 15 APRIL 2014 (5 days)	100	NO	1350	RESCHEDULE
3	RGT1 Maintenance SD	26 - 28 APRIL 2014 (3 days)	9 - 11 MAY 2014 (3 days)	400	NO	1250	RESCHEDULE
4	TCOT shutdown for CF renewal (tentative- pending DOSH approval for extension)	21 - 25 MAY 2014 (5 days)	16 - 29 AUGUST 2014 (14 days)	445	YES	1150	RESCHEDULE
5	Duyong maintenance activity impacting West Natuna	1 - 14 JUNE 2014 (14 days)		190	NO	1350	PLAN
6	TTM Maintenance SD	13 JUNE - 10 JULY 2014 (28 days)		400	YES	1150	PLAN
7	Lawit Complex SD	26 JULY - 6 AUGUST 2014 (12 days)		365	NO	1000 (Low demand Aidilfitri)	PLAN
8	TCOT maintenance SD	16 - 29 AUGUST 2014 (14 days)		(16-20/08) 445 (21-29/08) 295	YES	1150 (16-20/08)	PLAN
9	Resak Vessel Cleaning	1 - 7 SEPTEMBER 2014 (7 days)		315	NO	1350	PLAN
10	OSC Tr C shutdown for CF renewal	29 SEP – 6 OCT 2014 (8 days)	13 - 20 SEPTEMBER 2014 (8 days)	300	NO	1350	RESCHEDULE
11	RGT1 Turnaround	8 - 28 OCTOBER 2014 (21 days)		400	YES	1150	PLAN
12	Guntong E Complex SD	9 - 18 NOVEMBER 2014 (10 days)	Coincide with OSC tr C shutdown (13 - 20 SEPTEMBER 2014)	540	YES	NA	RESCHEDULE

- 12 number of planned gas curtailments.
- 72 days with shortfall exceeding 400mmscfd.
- Critical shutdown planned in 2014
  - June, 28 days of TTM shutdown during high demand period.
  - August, 14 days of TCOT shutdown.

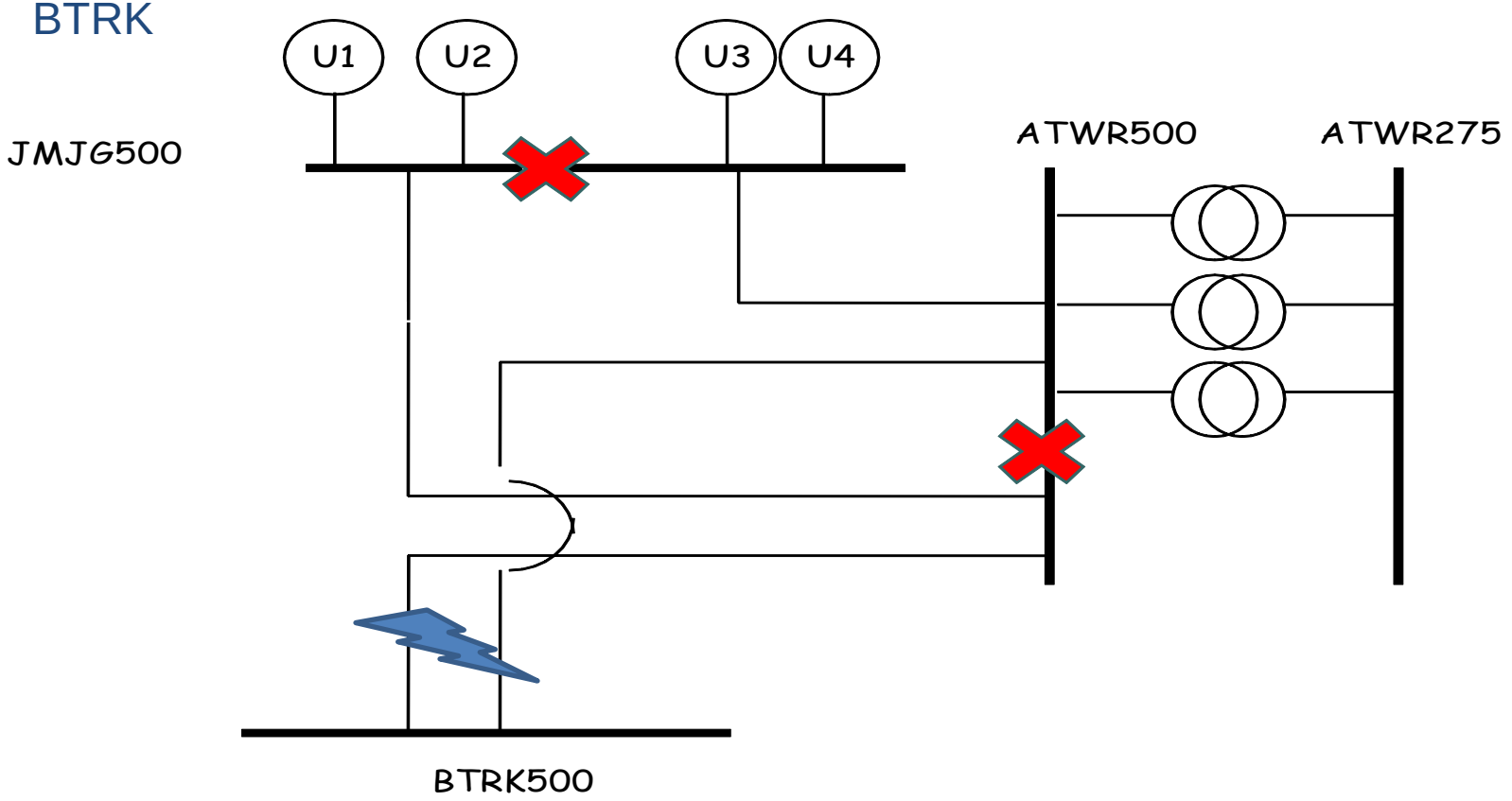
THREAT OF LOSS MAJOR TRANSMISSION CORRIDORS

MAXIMUM DEMAND (28/05/14)	• 16,583 MW
CENTRAL AREA MAX. DEMAND	• 7,498MW

Transmission constraint with JMJG U4

Proposed network configuration during and after commissioning of JMJG U4 (Before Point A is ready)

✓ Split JMJG500 and ATWR500 with either 1400MW or 1700MW direct to BTRK



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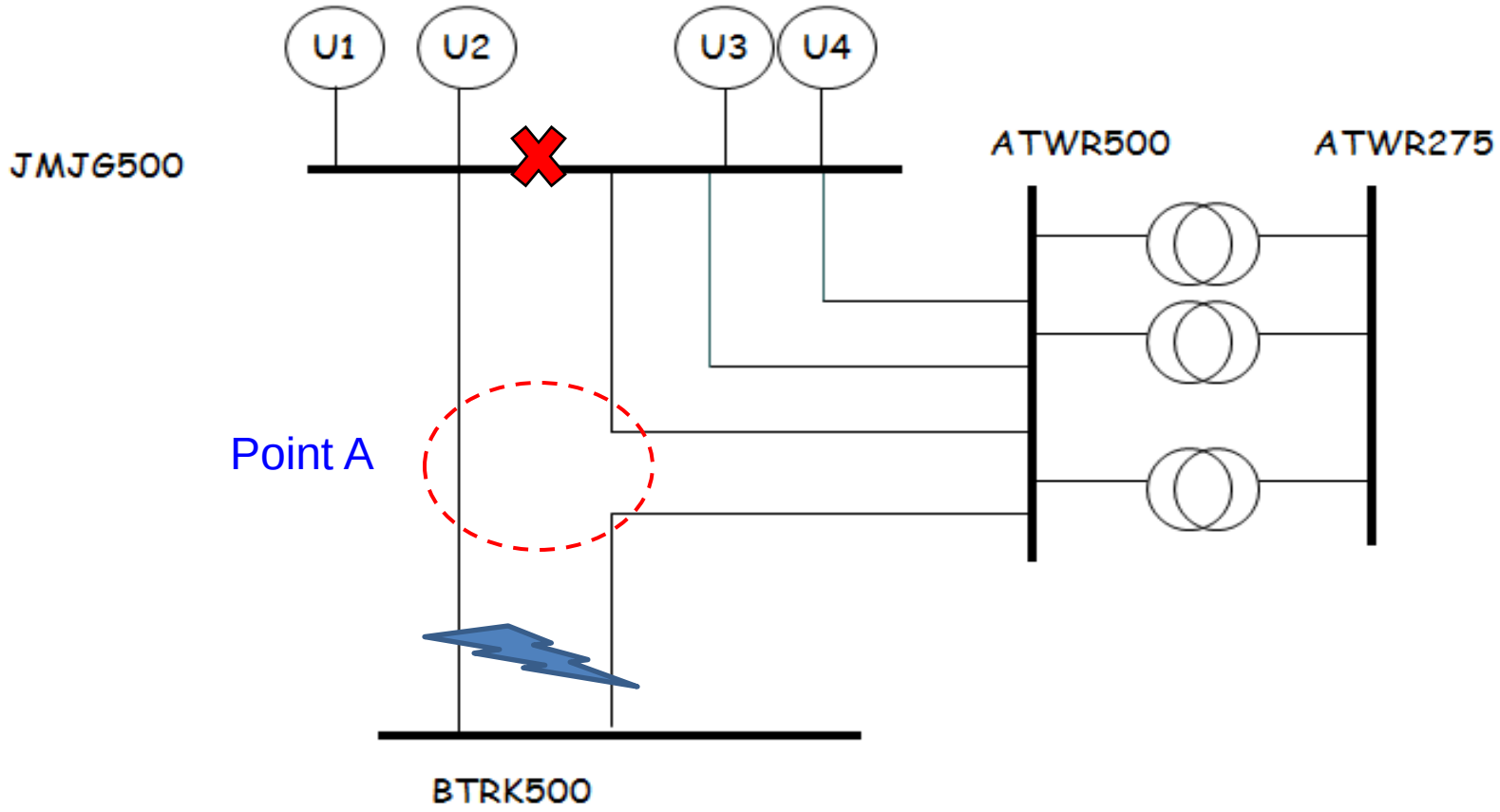


E-ATTEND SCHEME

- The original 500kV LILO configuration has the risk of Out of Step and voltage problems for contingency n-2 BTRK-JMJG/ATWR

- Incompletion of point A will further reduce system reliability where:
  - Propose to split JMJG and ATWR with 1400MW or 1700MW directly connected to BTRK
  - n-1 of the circuit with 1700MW attached will possibly trigger UFLS

- Contingencies can cause overload on the parallel 275kV lines can be handled by a Special Protection Scheme called E-ATTEND with enhanced functionality – to reduce generation at JMJG/SGRI and/or trip SGRI and/or load shedding in Central area

- E-ATTEND scheme recommends to include these functions:
  - HVDC Run-back
  - Direct Hydro Intertrip Scheme (DHIS)
  - Event-based Load Shedding (at 49.5Hz)

DEMAND CONTROL ON 7TH MAY 2014

DEMAND CONTROL IN MALAYSIAN GRID CODE

Operating Code No. 4 (OC4) governs the procedures to be followed by the GSO and Users to facilitate **Demand Control**

in the event that **insufficient generating capacity** is available to meet forecast or real-time Demand

the possibility of **frequency excursions** outside the limits given in the Planning Code.

Demand Control shall include but not limited to the following actions on load or demand:

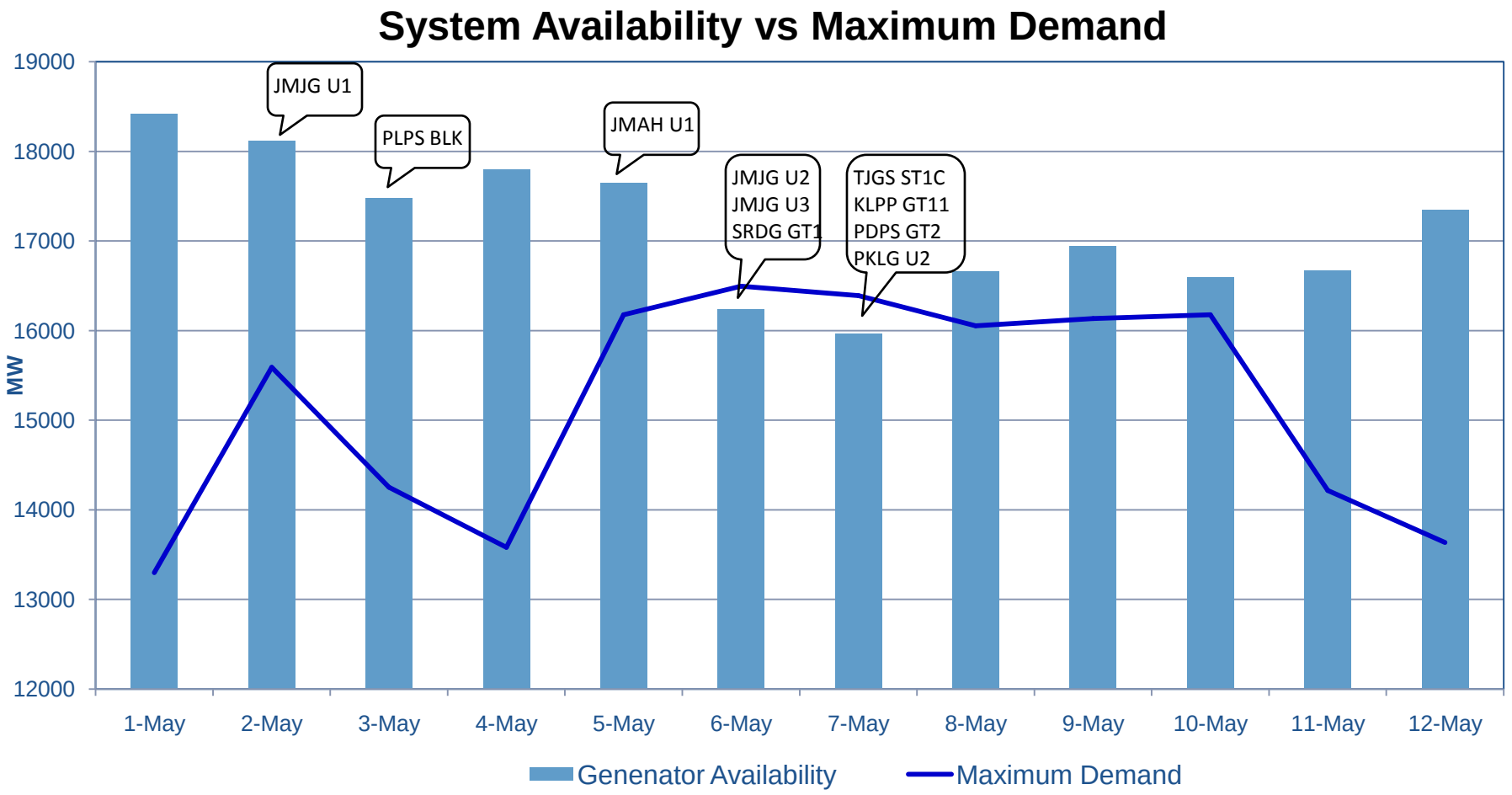
- (1) Automatic load or demand shedding;
  - Under frequency Load Shedding Scheme
  - Under Voltage Load Shedding Scheme
- (2) Manual load or demand shedding; and
  - Load Shed & Restore (LSR)
  - ROTA Load shedding
- (3) Reduction of load through voltage reduction;

These provisions may be used by the GSO to prevent System thermal overloads or System voltage collapse on any part of the Grid.

NOTIFICATION FOR DEMAND CONTROL

YELLOW WARNING	A Yellow Warning, Probable Risk of Demand Reduction will, where possible, be issued by the GSO, one (1) week before the anticipated event, when the GSO anticipates that it will or may instruct Users to implement Demand Reduction, providing in writing the percentage level of Demand Reduction it may wish to instruct from each User.
ORANGE WARNING	An Orange Warning, High Risk of Demand Reduction will, where possible, be issued by the GSO, twenty four (24) hours before the event, in writing, when the GSO anticipates that it will or may instruct Users to implement Demand Reduction.
RED WARNING	A Red Warning, Extremely High Risk of Demand Reduction will, where possible, be issued by the GSO, thirty (30) minutes before the event, by telephone instructions, by fax or in writing, when the GSO anticipates that it will or may instruct Users to implement Demand Reduction.

GENERATION SHORTAGE TO MEET THE DEMAND



- Multiple forced outages of generators since 2nd May 2014.
  - Availability reduced from 18400MW to 15900MW.
- System survived on 6th May 2014 – Imported from EGAT and Singapore.
- Generation and demand unbalance very huge on 7th May 2014. GSO resorted to load shed to protect the grid system.

SEQUENCE OF EVENT ON 7th MAY 2014

7th May 2014 morning, generation availability was already **low** due to previous day forced outage of JMJG U2 and U3.

@ 0524hrs

TJGS Blk 1 (240MW) tripped due to faulty control valve.

@ 1238hrs

PKLG U2 (145MW) tripped due to cooling water pump failure.

@ 1450hrs

PKLG U1 (285MW) tripped due to cooling water pump failure.

0600 | 0700 | 0800 | 0900 | 1000 | 1100 | 1200 | 1300 | 1400 | 1500 | 1600 | 1700

9:00 - 17:00

Steel Mills were requested to stop arcing in order to reduce demand.

15:35 - 17:20

Restoration of supply after PKLG U2 was back online @1521hrs.

Red Warning was cancelled @1720hrs with **Orange Warning** reinstated.

@ 0900hrs

started IMPORT from Singapore & Thailand.

@ 1345hrs

RED warning was issued.

@ 1411hrs

ROTA was initiated and followed by **EMLS** which amounting to a total of **470MW load interruption.**

THANK YOU