# APEC Workshop on Small Hydro and Renewable Grid Integration, Ha Noi, Vietnam

# Issues on grid integration of small scale RE electricity APEC Economies—Electric Utilities Perspective

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# INTRODUCTION

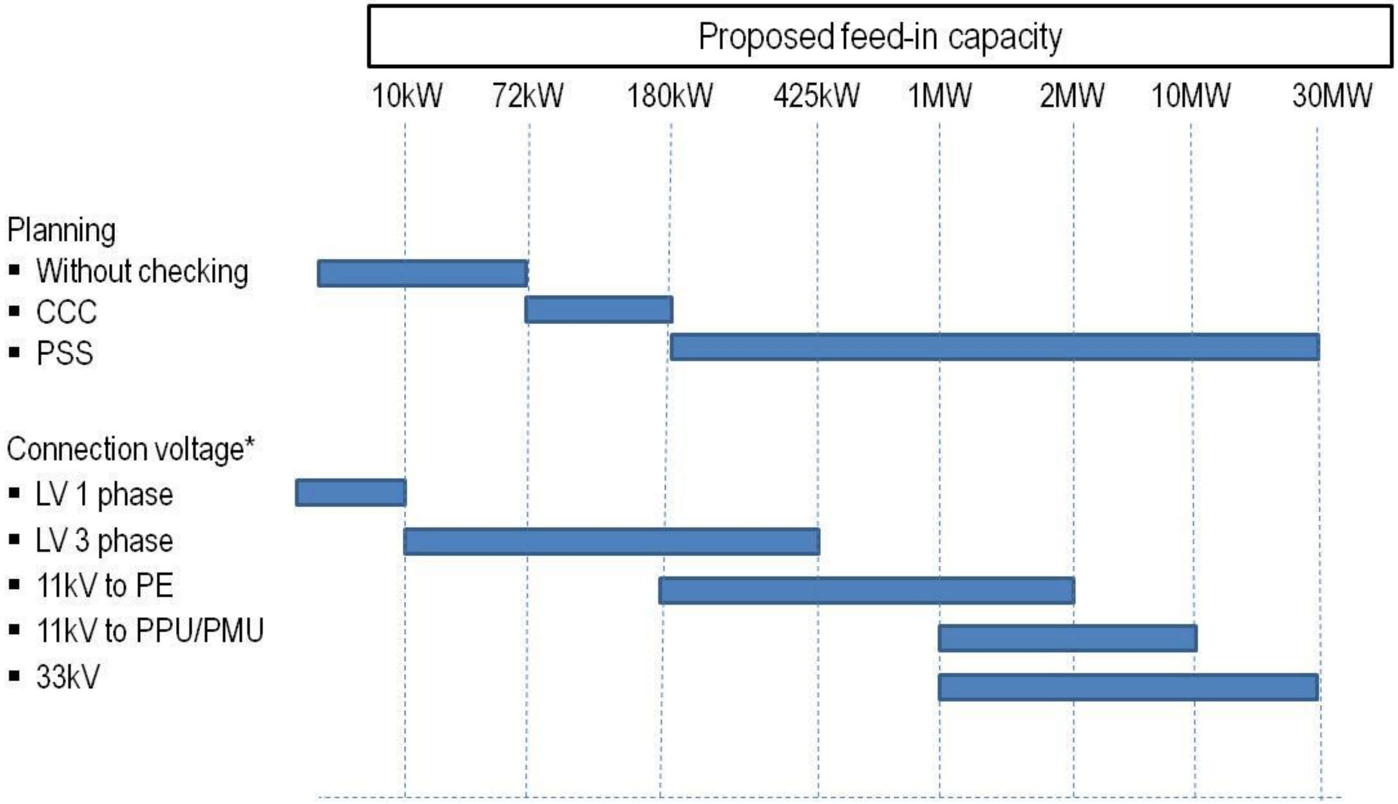
# INTRODUCTION

- Small Renewable Energy scenario in TNB

| Types | TNB | RE developer |
|---|---|---|
| Mini hydro | 20 sites (97MW) | 4 sites (29.2MW) |
| Solar PV | - | 20 sites (25.5MW) |
| Biomass | - | 3 sites (20MW) |
| Biogas | - | 6 sites (7MW) |

- Feed-in Tariff in 2011 (up to 30MW)
  - Regulators : Electricity Commission Malaysia
    SEDA Malaysia

# INTRODUCTION




- Connection point is based on RE output capacity

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# REFERENCES

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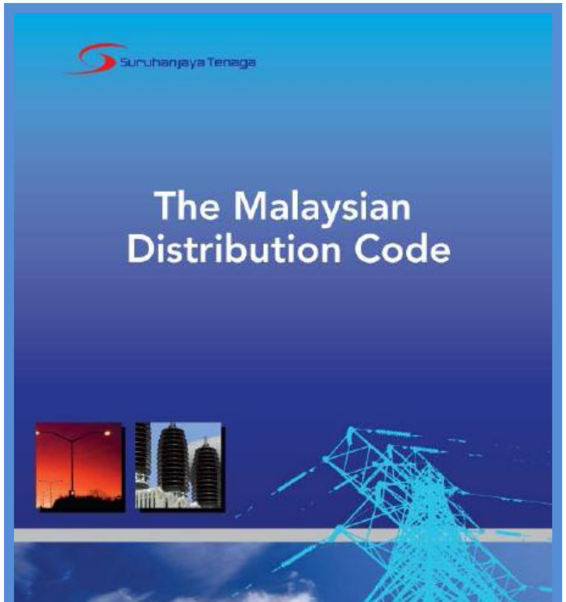
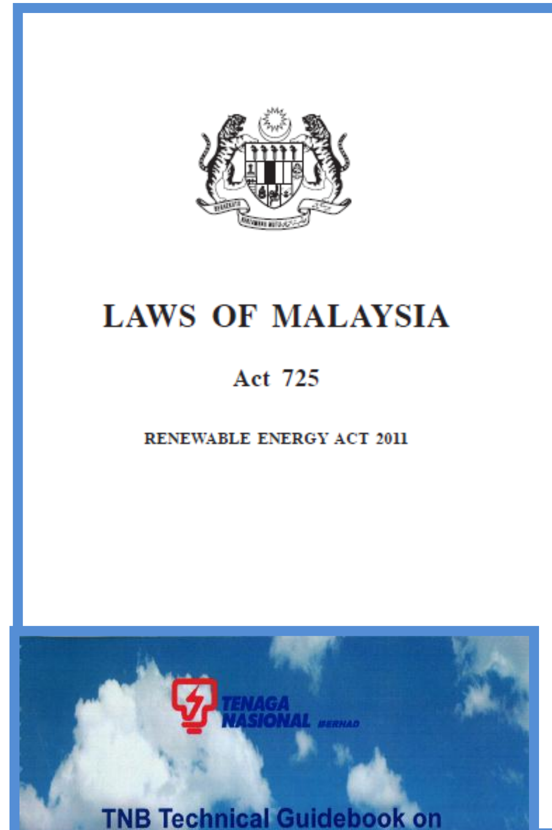
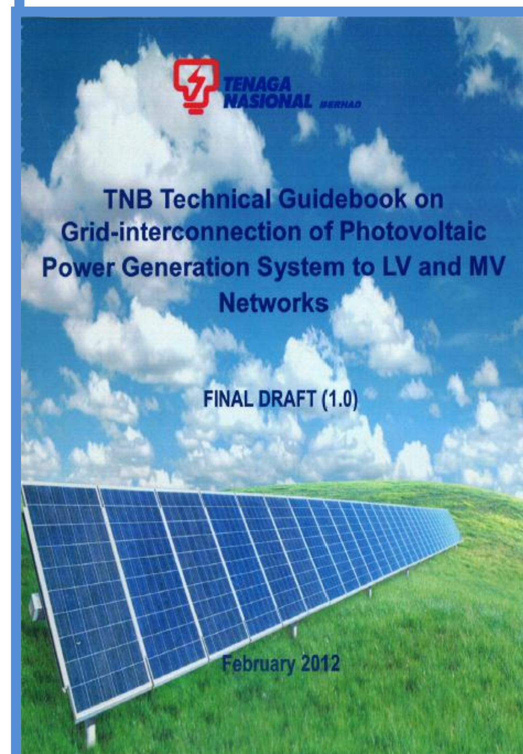


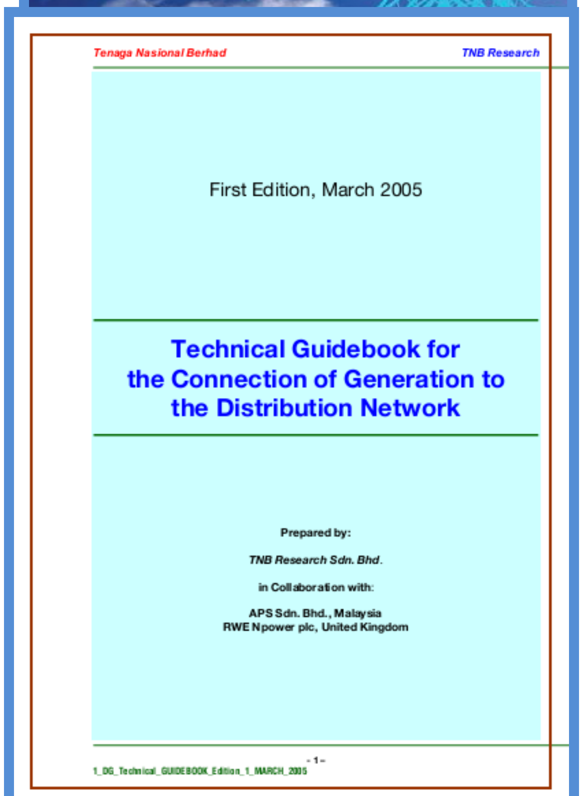




Renewable Energy Act, 2011
(SEDA Malaysia)

Distribution Code
(Energy Commission Malaysia)




Connection of PV Generation
(TNB)




DG Generation Guidebook
(TNB)

# TNB GREEN ENERGY POLICY

"TNB is committed to support the national green agenda and minimise the environmental impact of our business by applying sustainable, efficient operations and delivering green energy through the application of appropriate technologies and investments".

# ISSUES

# ISSUES

a) Voltage regulation

i- MV

- Proposed RE sites are away from load centre : low load, smaller cables
- High generation results in out-of-range voltage ( ±5%)
  - Reduce generator pf
  - Install reactor
  - Install larger cable
  - Reduce capacity
  - Connect to higher voltage
  - Upgrade utility cable/line

ii- LV

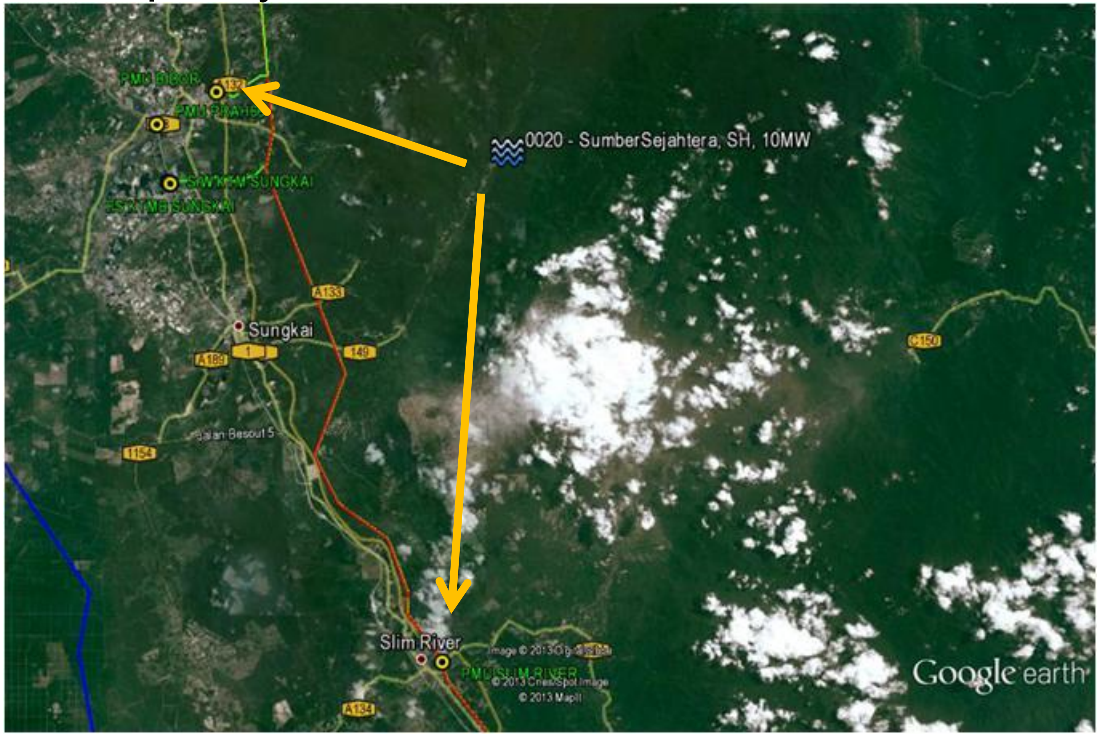
- Voltage increase during low load causing inverter to trip

# ISSUES

b) Nearest connection point is a "weak" system

- Low load
- Small cable, bottleneck
- Long interconnection cable/line required to connect to suitable substation

  >>> Reduced generation capacity

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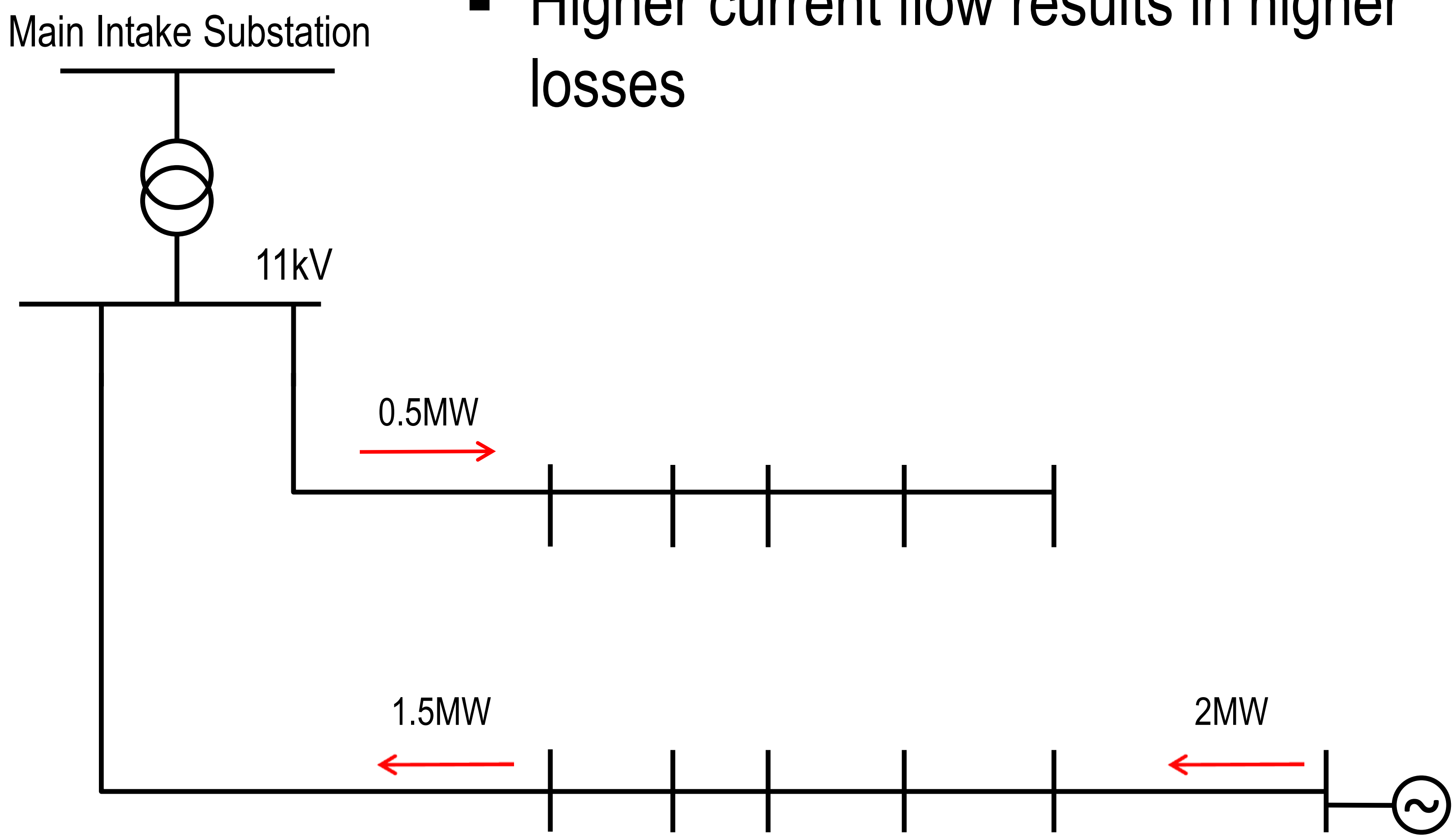
# ISSUES

c) Network losses due to reversed power flow & supply of Var

- Higher current flow results in higher losses

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# ISSUES

d) High system fault level

- Addition of RE generators exacerbate
  - 33kV 25kA
  - 11kV 20kA, 25kA

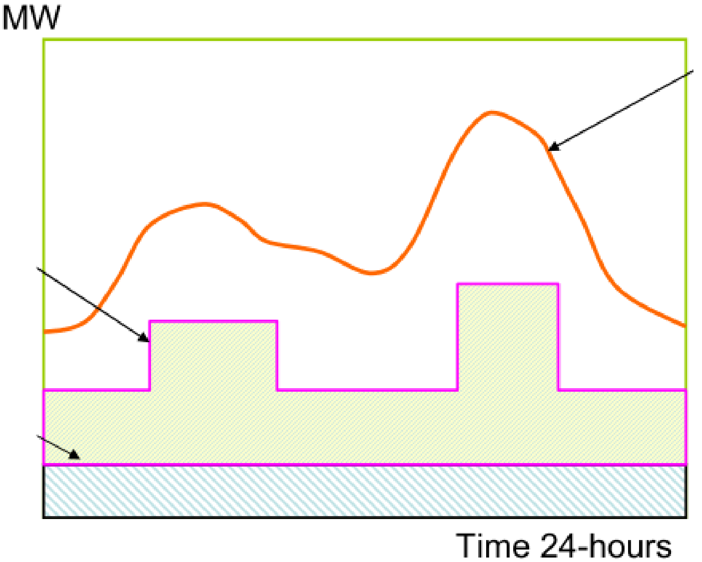
>>>Unparallel transformers

Reduce fault contribution from RE

# ISSUES

e) Penetration limit

- Based on capacity
- Based on existing trough load
- Based on expected voltage rise




>>> Prevailing limit is 85% of trough load, TNB is currently reviewing the limit

# ISSUES

f) Favourite sites

- Some sites are favoured by RE developers resulting in high number of proposals due to:
  - Cluster of potential rivers
  - State government support
  - “Cheaper” land
    - Penetration limit
    - Insufficient space for additional switchgears at Main Intake Substation

# ISSUES

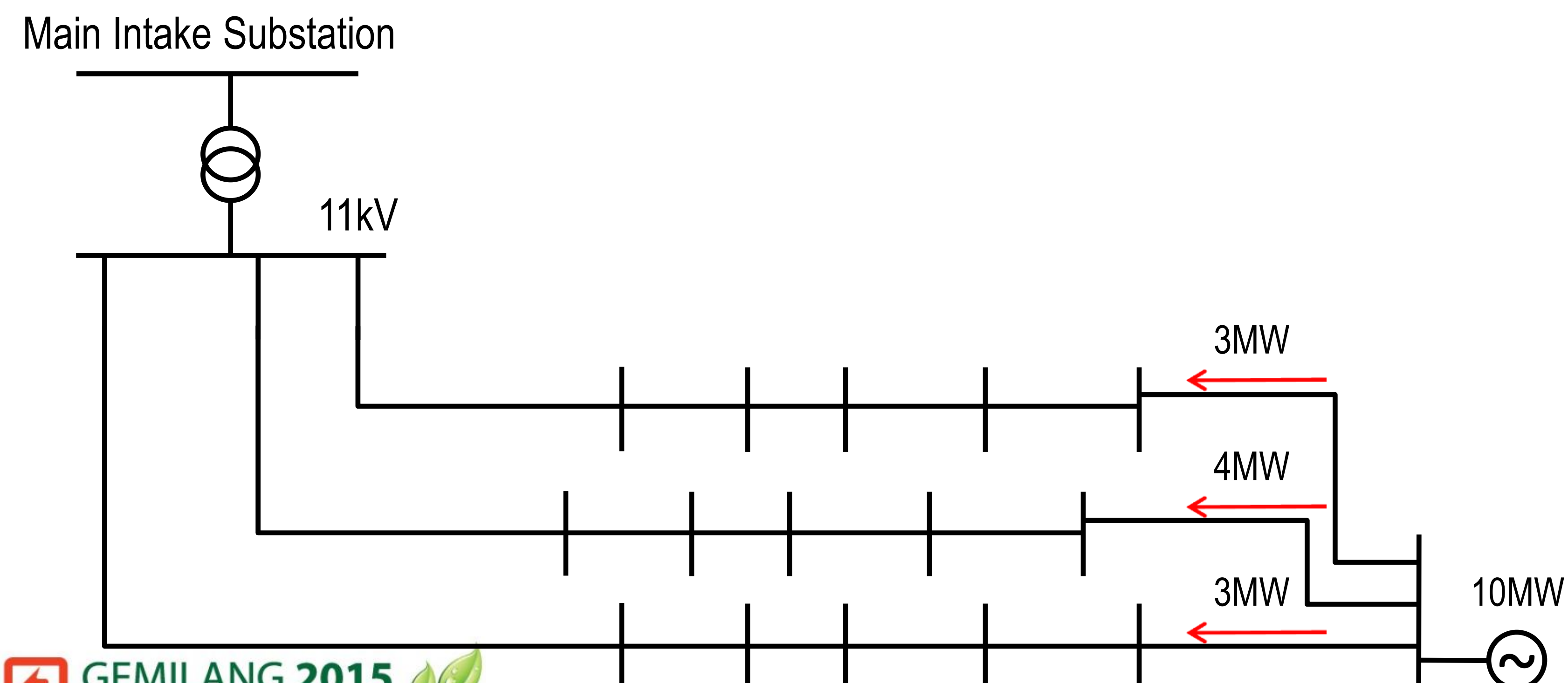
g) Upgrading at existing substation/feeder

- Existing small substation
- Connection from multiple developers
- No nearby existing substation
- RE site nearest to worst performing feeder

# ISSUES

## h) Numerous connection schemes

- Multiple feed causing difficulty to isolate fault during operation
- Standardised for FiT connections
  - Single connection point
  - Standardised connection point based on connected capacity

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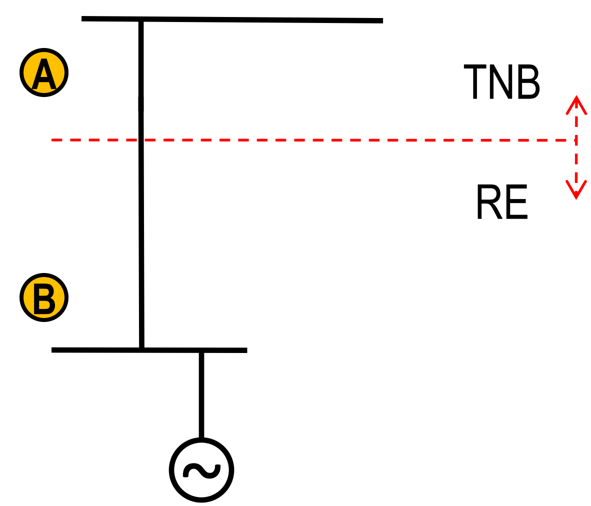
# ISSUES

>>>Standardised interconnection feeder

- Interlocking scheme to ensure TNB equipments not used to sync
- Interfacing with TNB
  - Cable – Unit Protection and OCEF
- Interlocking facilities
  - A trip – B to trip
  - B close position – A cannot close
  - A open position – B cannot close
  - Earth switch B ON – A cannot close

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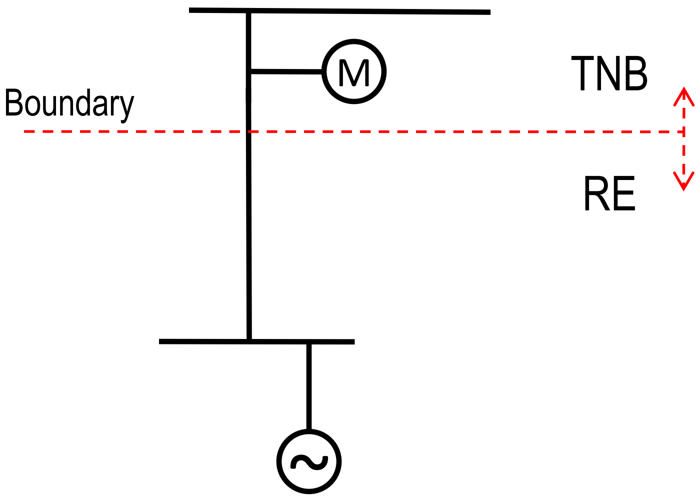
# ISSUES

i) Boundary of ownership/operation

- Energy meter installed at connection point ie TNB substation. Energy meter reading by Remote Metering
- Ownership of RE developer until connection point
- Interconnection Operation Manual (IOM) for every site

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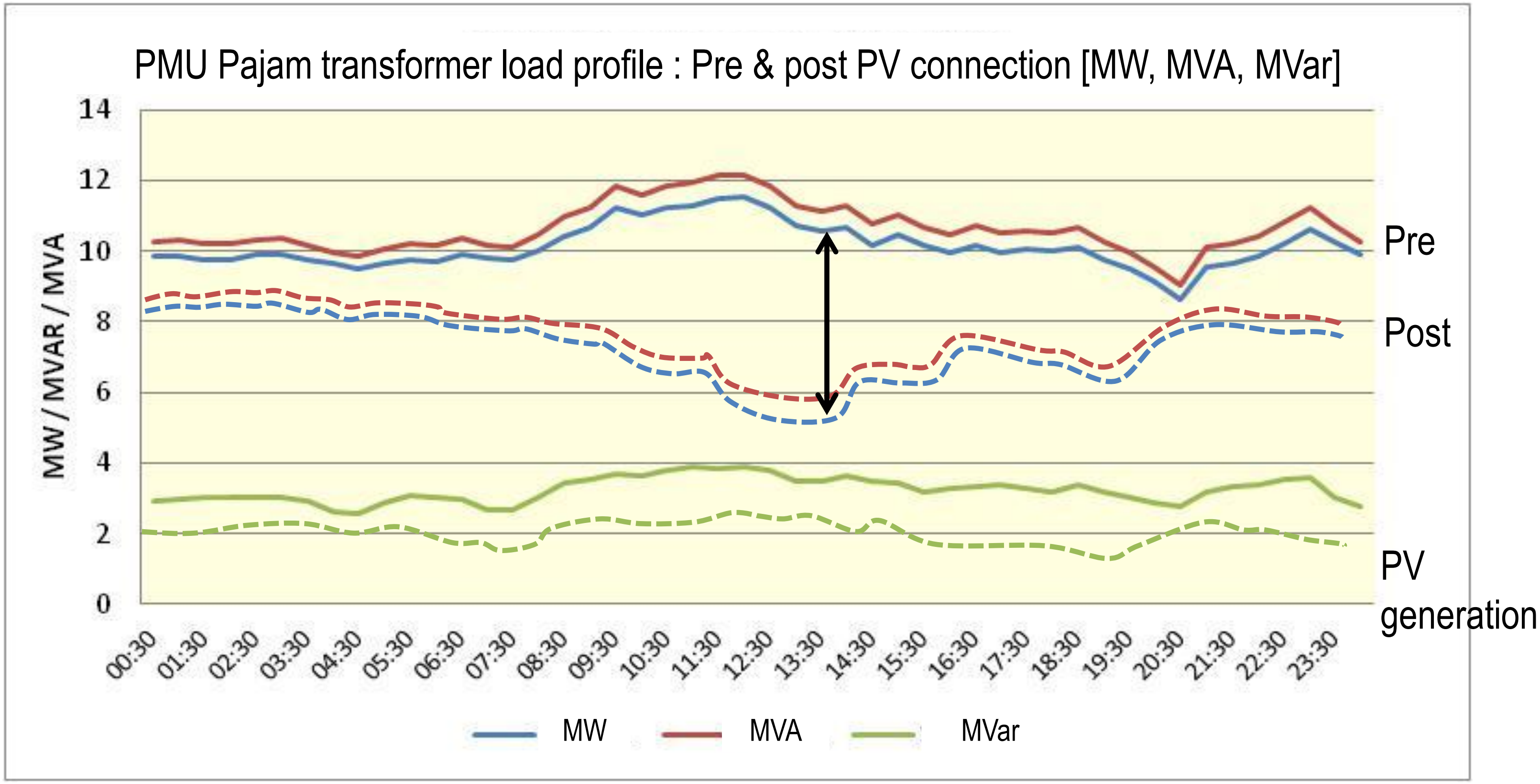
# ISSUES

j) Inconsistent energy output (steady state)

- Solar : due to varying solar irradiance
- Biomass : due to unavailability of biomass, fuel
- Biogas : due to inconsistency of gas – sanitary landfill, anaerobic digestor
- Hydro : due to reduced waterflow

# ISSUES

## k) Reduced Main Intake Substation capacity utilisation




| | Without RE | With RE |
|---|---|---|
| PMU | 11.5 | 5.5 |
| RE | 0 | 6.0 |

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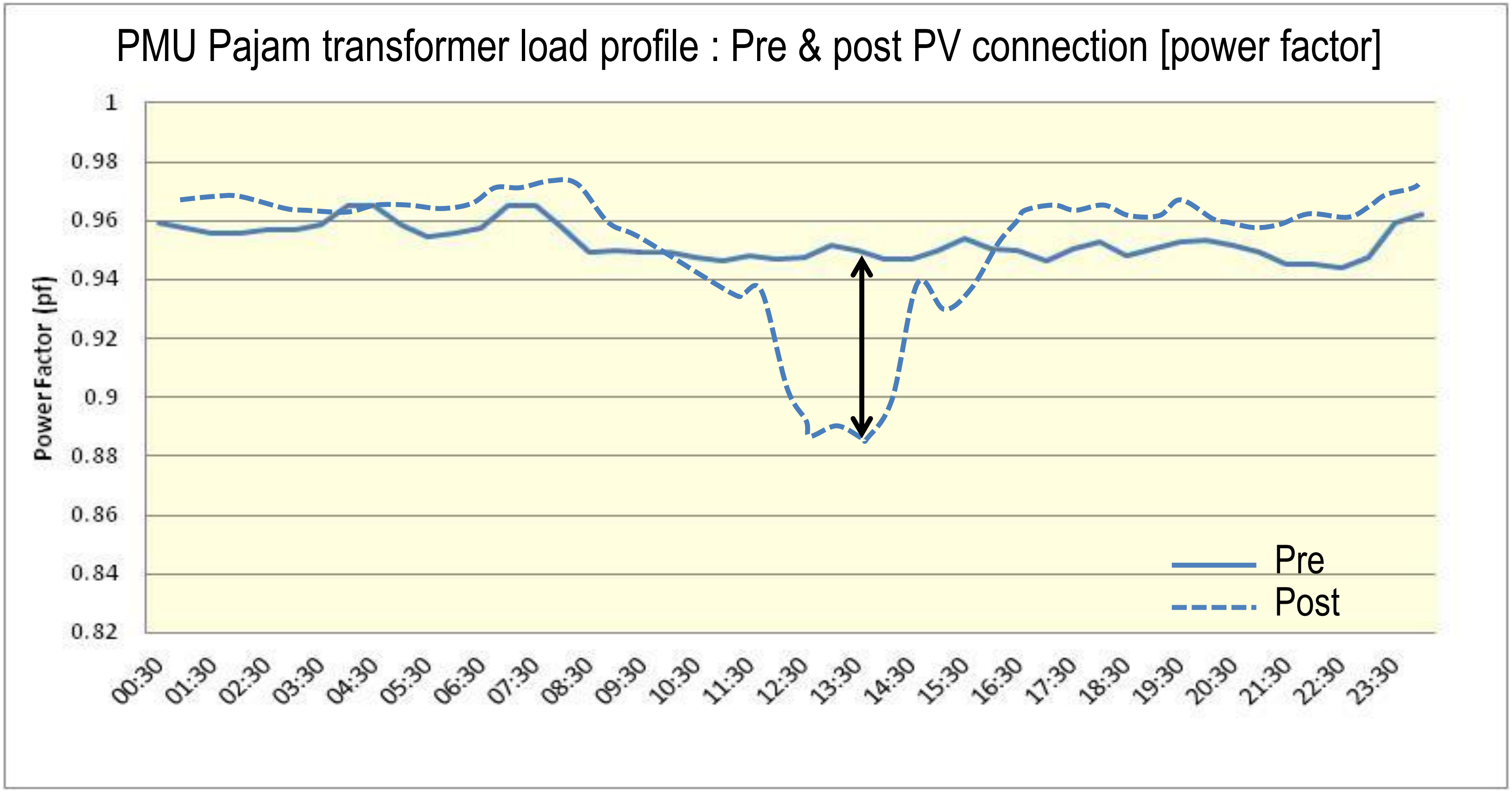
# ISSUES

## I) Change in Main Intake Substation power factor




- Reduced substation power factor due to reduced P, increased Q

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# ISSUES

m) Exact machine data not available during power system study

- Use of typical parameters

# ISSUES

n) Increase maintenance of substation equipment

- Use of VCB switchgears at connection points

Before

After

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# CONCERNS

i) Safety of workmen during operation
ii) Harmonic contribution to distribution network
iii) Yo-yo like energy output complicates load forecast, capacity planning
iv) Local industry technical support - skilled

# Terima Kasih

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