DISTRIBUTED GENERATION

Planning Issues
for the Electricity Distributor

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Summary

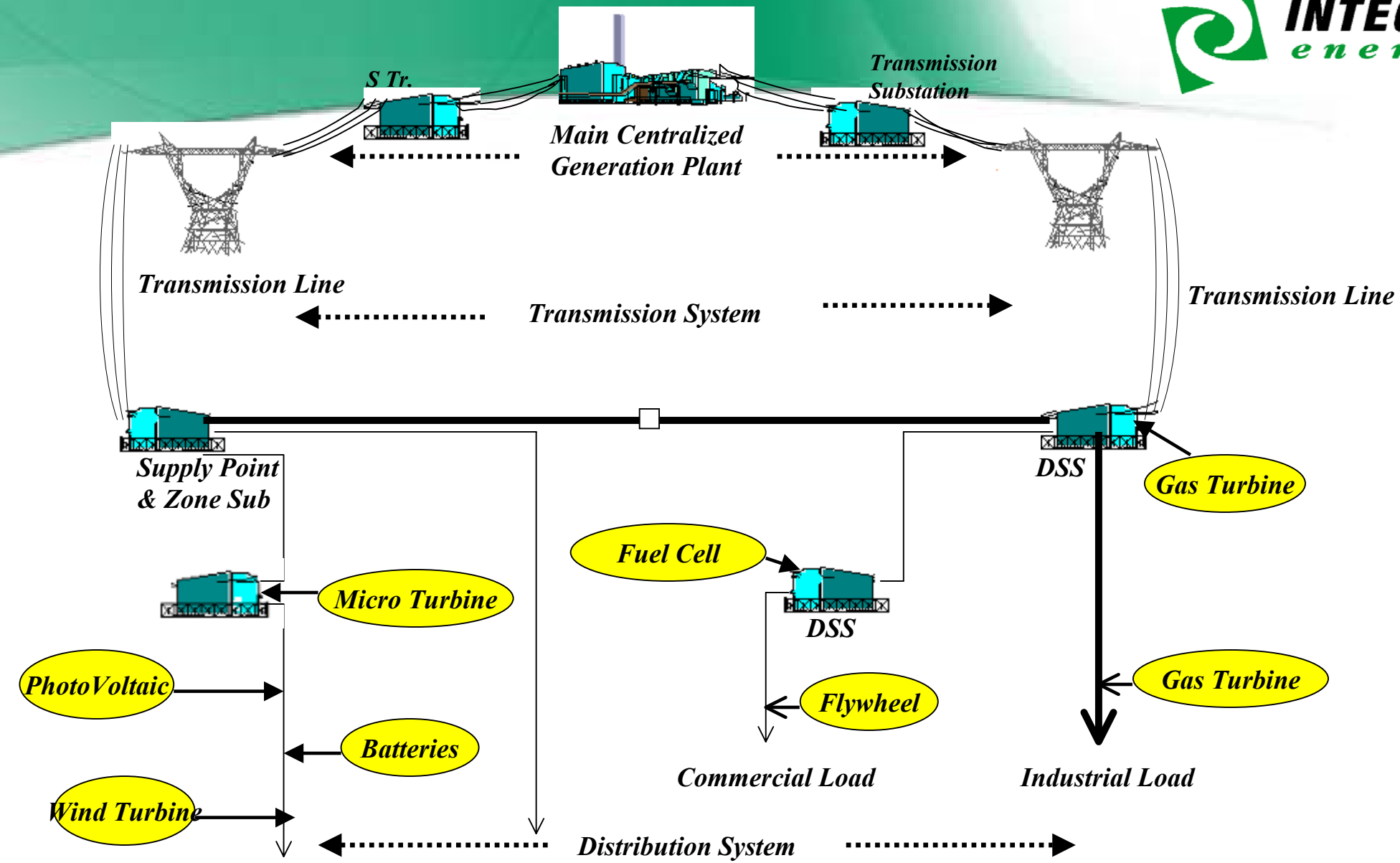
- Responsibilities of Electricity Distributor
- Planning issues
  - Variety of distributed generation
  - The positives and negatives
    - Potential deferment of expenditure
    - Positive environmental impact
    - Voltage control issues
    - Safety issues
    - Impact on capital expenditure
    - The market

Responsibility of Electricity Utility

- Two dimensions
  - RETAIL - fully contestable; energy trading- buying and selling; regulatory requirements re renewable energy (REC's)
  - NETWORK - provision of the physical infrastructure to meet appropriate quality of supply. The subject of this presentation
- Principal planning objectives for network:
  - Adequate capacity of network to supply load
  - Adequate level of redundancy (security standards)
  - Adequate safety, fault rating of components and ability to protect
  - Adequate power quality (voltage, frequency, harmonics, etc)
  - Adequate reliability of network

IMPACT OF DISTRIBUTED GENERATION

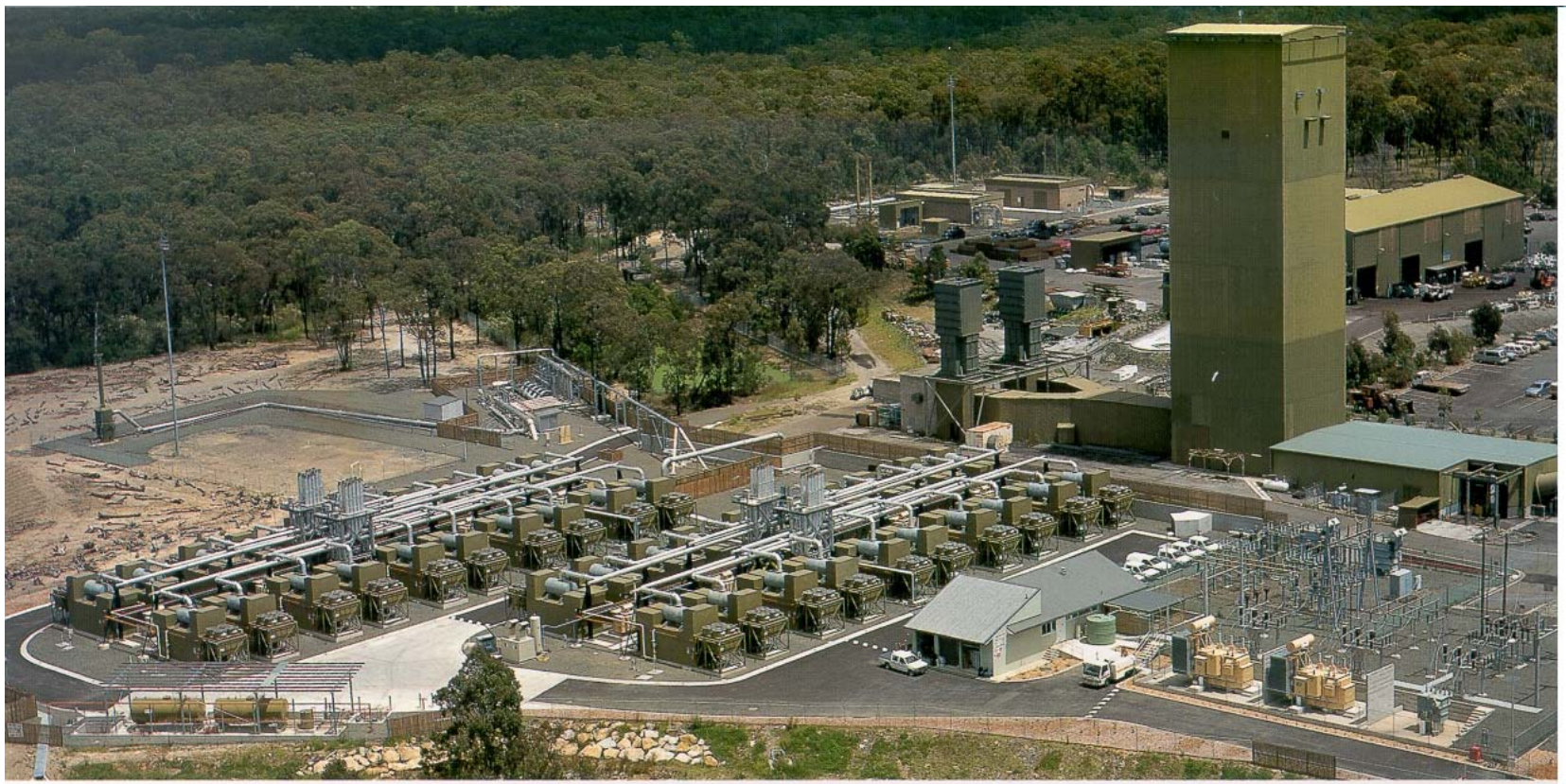
- Previously:
  - only source from transmission system - vertically operated
- With distributed generation:
  - sources can be embedded anywhere in network
  - wide variety of types and characteristics of distributed generation
  - wide variety of impacts on network



Distribution Network Is No More Vertically Operated

Ref: Walid El-Khattam University of Waterloo, Canada

Example of a large coal seam gas extraction plant



POSITIVES

- Can potentially result in deferment of expenditure on the network
- Reduces network losses
- Can improve local voltage level
- Can have a positive environmental advantage
  - Coal Seam gas extraction utilises gas that otherwise vented
  - Wind turbines utilise natural wind energy
  - Solar cells utilise available sunlight
- Combined heat and power improves overall energy efficiency
- Can assist with achieving Greenhouse targets by displacing coal-based electricity generation

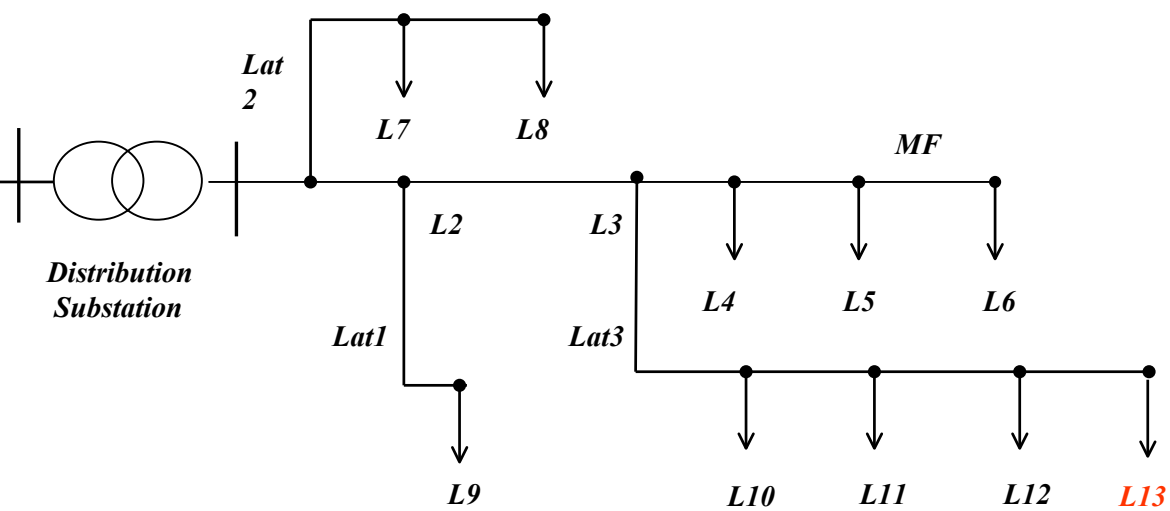
NEGATIVES - or challenges for the distributor

- Many difficult technical challenges need to be overcome
  - » Fault level contribution - does it add to fault level, current limiting?
  - » Impact on voltage level - where voltage regulation high can be problem
  - » Reliability / availability - does it defer capital expenditure?
  - » What level of redundancy is available? Maintenance shutdown?
  - » Does supply match load requirements? Wind, solar
  - » Impact on performance of protection systems - can affect reach
  - » Safety risk associated feedback into network
  - » Impact of islanding
  - » Effect on normal operating techniques - single phase switching
  - » Impact on operation of voltage regulators

Challenges (Cont'd)

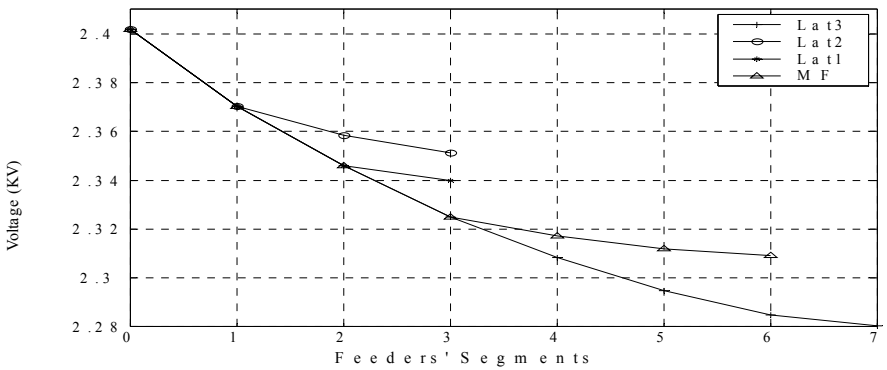
- As the characteristic of the various types of embedded generation are quite different, each needs to be separately analysed
- Economic drivers that electricity distributors face in the market do not match proponent's objectives - IPART has been conducting review - refer interim paper
- Connection costs can be high to meet technical issues
- Impact of embedded generation on a weak electrical system - particularly voltage control
- Monitoring of performance of system

Voltage Impact

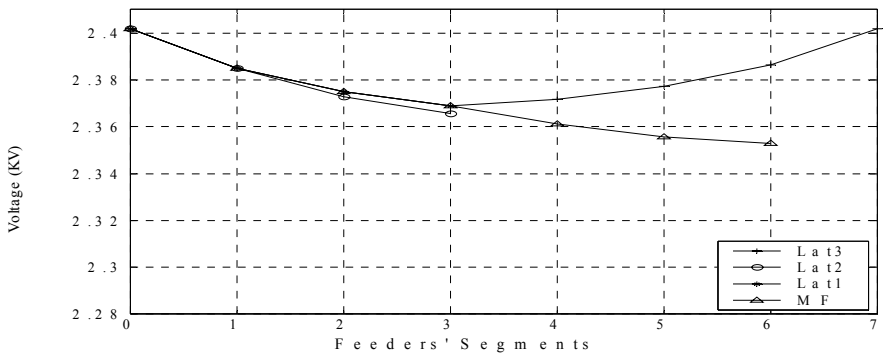


Typical network

Problem of voltage range with and without generation



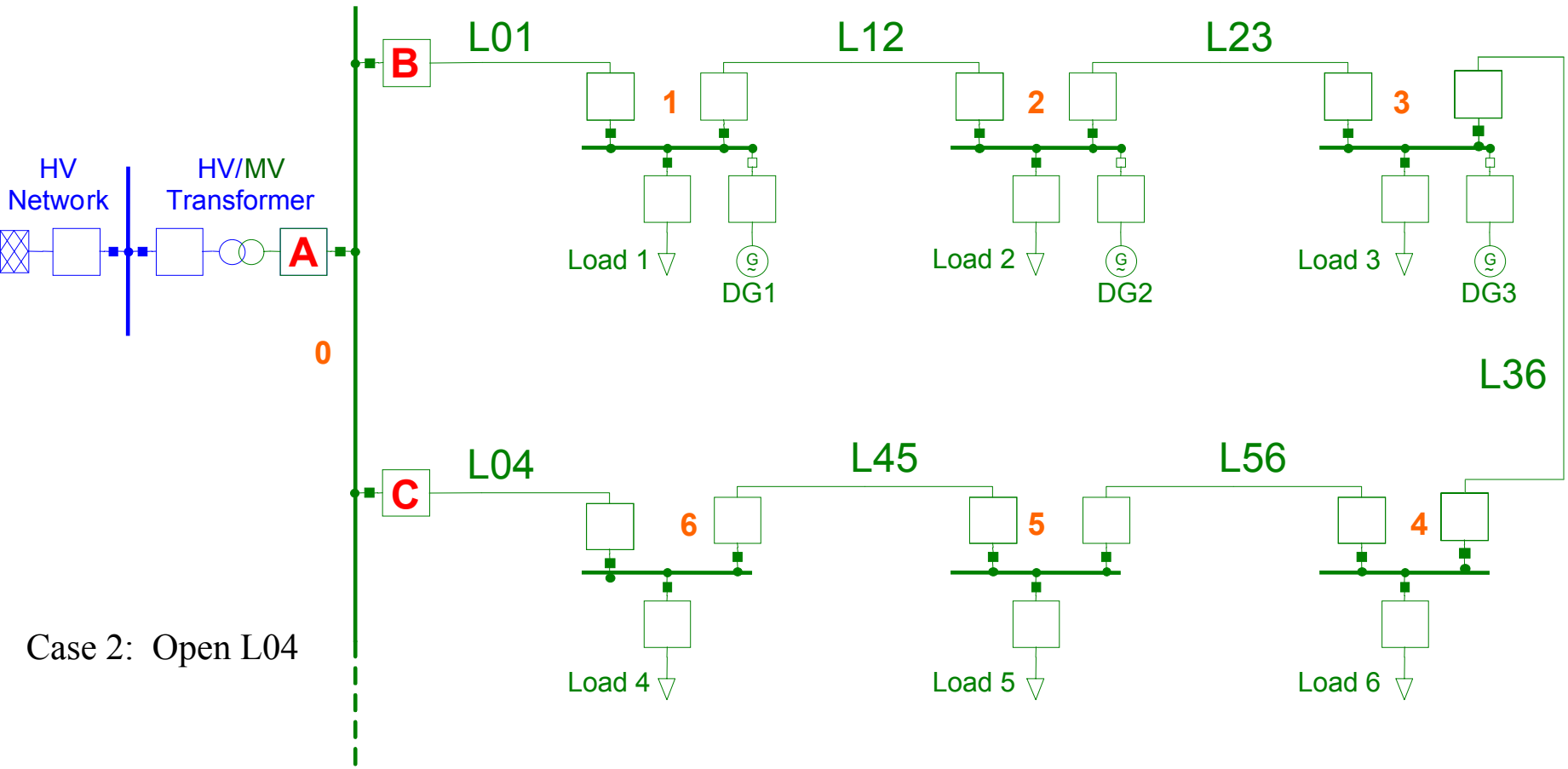
Without generation



With generation at L13

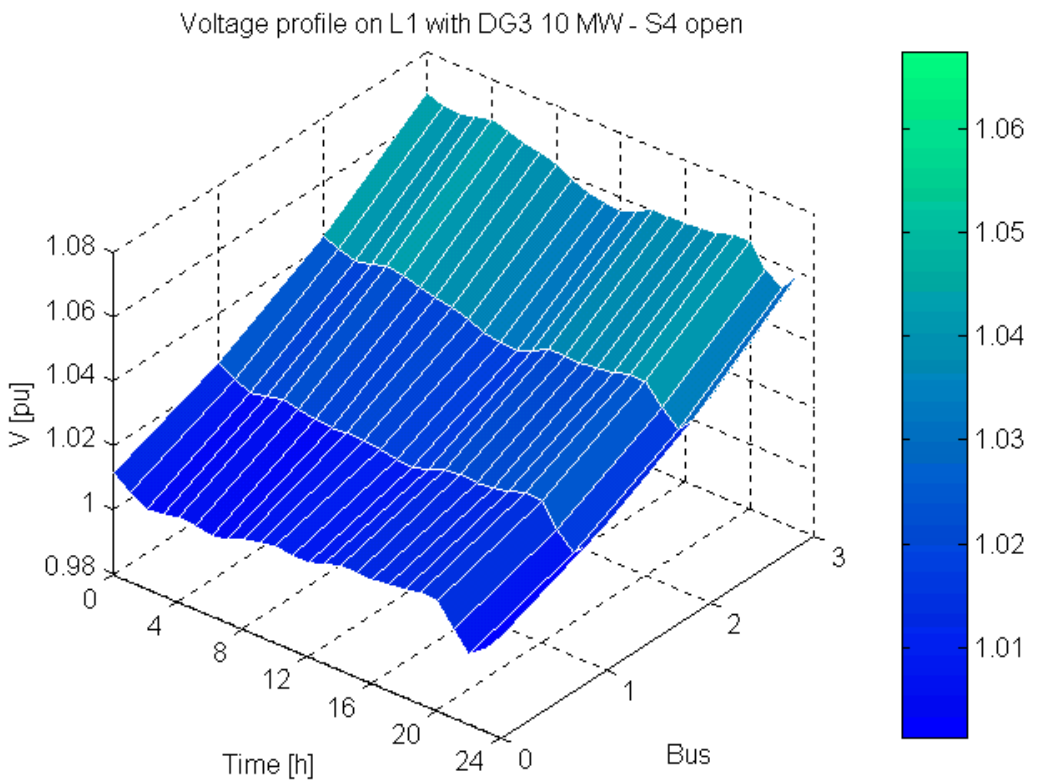
Voltage profile

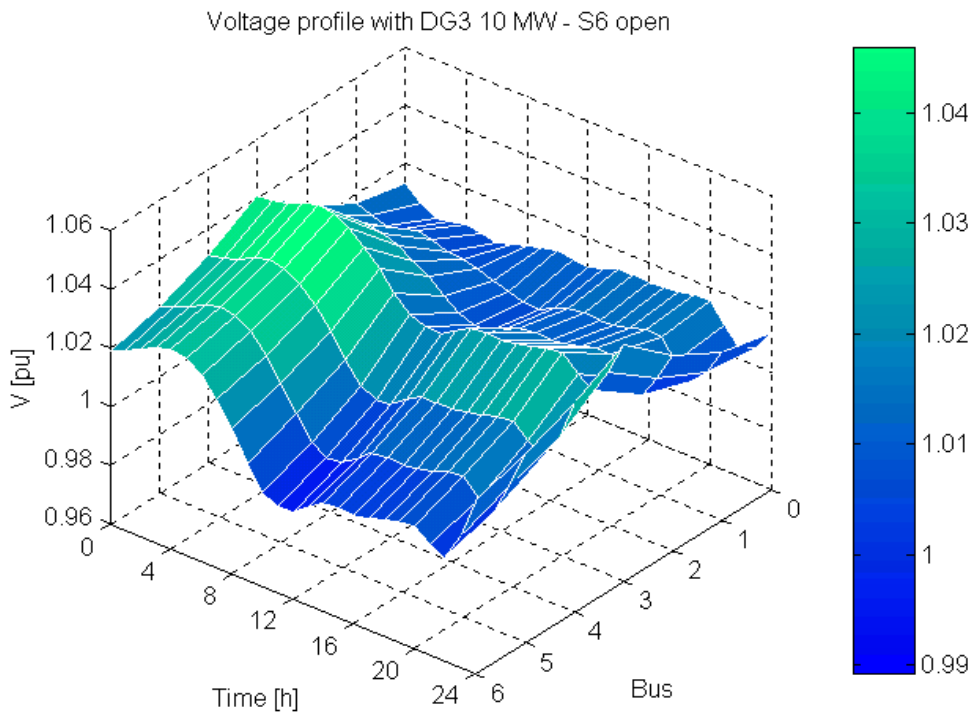
Case 1: Open L36



Case 2: Open L04

Voltage Impact





Ref: A. AGUSTONI, M. BRENNA, R. FARANDA, E. TIRONI, G. SIMIOLI
Distributed Generation Control Methodologies and Network Reconfiguration:
Effects on Voltage Profile Politecnico di Milano Dipartimento di Elettrotecnica
March 13, 2002

Embedded Generation

- Alternative source of energy
- Predominant benefits are upstream
- Power flow and voltage profile of local feeder is affected
- May result in increased expenditure on the distribution system.
- Reliability issues
- No mechanism to capture upstream benefits
- Presents many challenges to the electricity distributor to meet its obligations with respect to Quality of Supply