EVALUATION OF ANTI-ISLANDING PROTECTION SCHEMES

INDIAN CONTEXT

Renewable Energy World India

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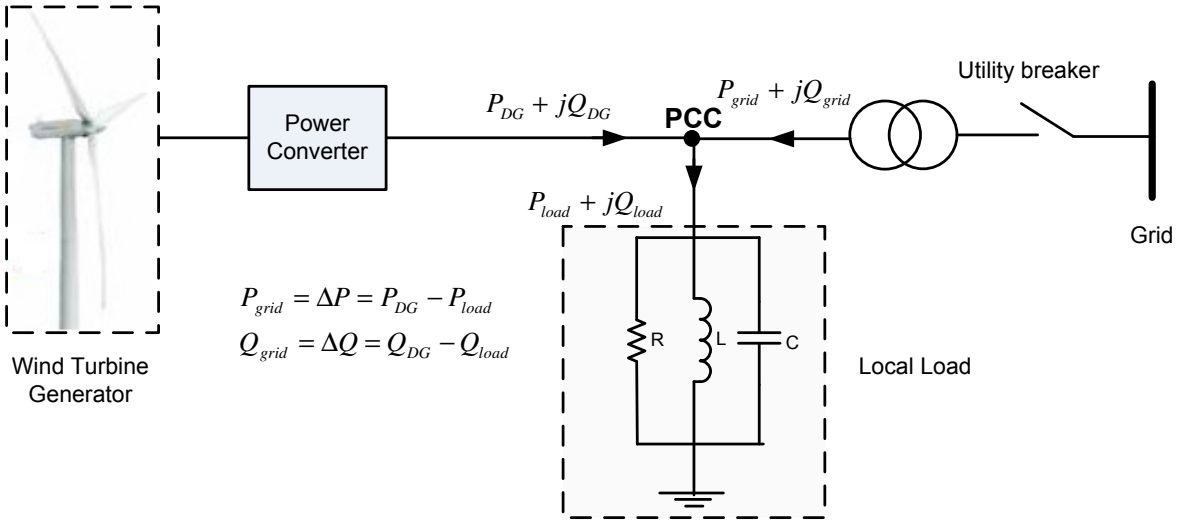
EVALUATION OF ANTI - ISLANDING SCHEMES

- Distributed Generation
- Islanding
- Anti-Islanding protection
- Passive schemes and NDZ
- PJD applied to weak grid
- Simulation results
- Conclusion

Distributed Generation

Introduction and advantages

- Distributed Generation (DG) is utilizing the generated power at the same location where it is produced keeping the fact in mind that RE plants are having less generation capacity compared to conventional power plants.
- Power loss due to transmitting power to the grid is reduced
- Remote locations can be electrified with DG



Grid Connected RE Systems

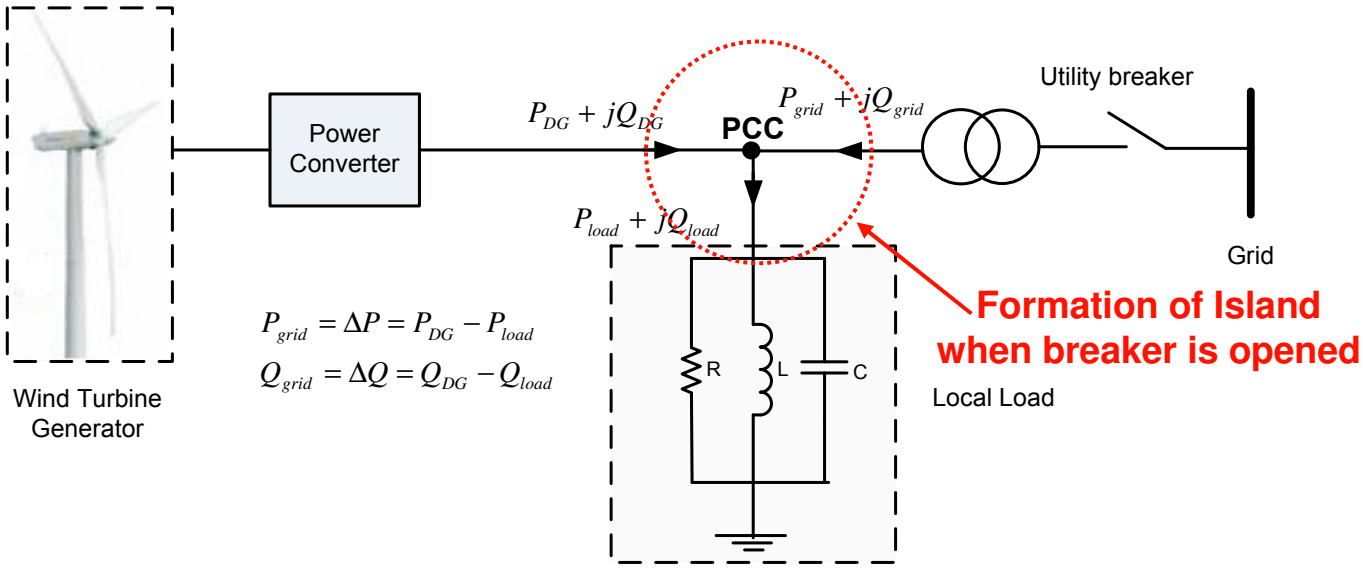
Challenges and Issues

- **Islanding**
- **Dynamic interaction between various generators**
- **Conflict in voltage control for generators in proximity**
- **Power Quality**
- **Weak Grid situations**

Islanding

Introduction

- When loads are being fed power from DG **even** after the power supply is suspended from utility **- Islanding Condition at PCC**



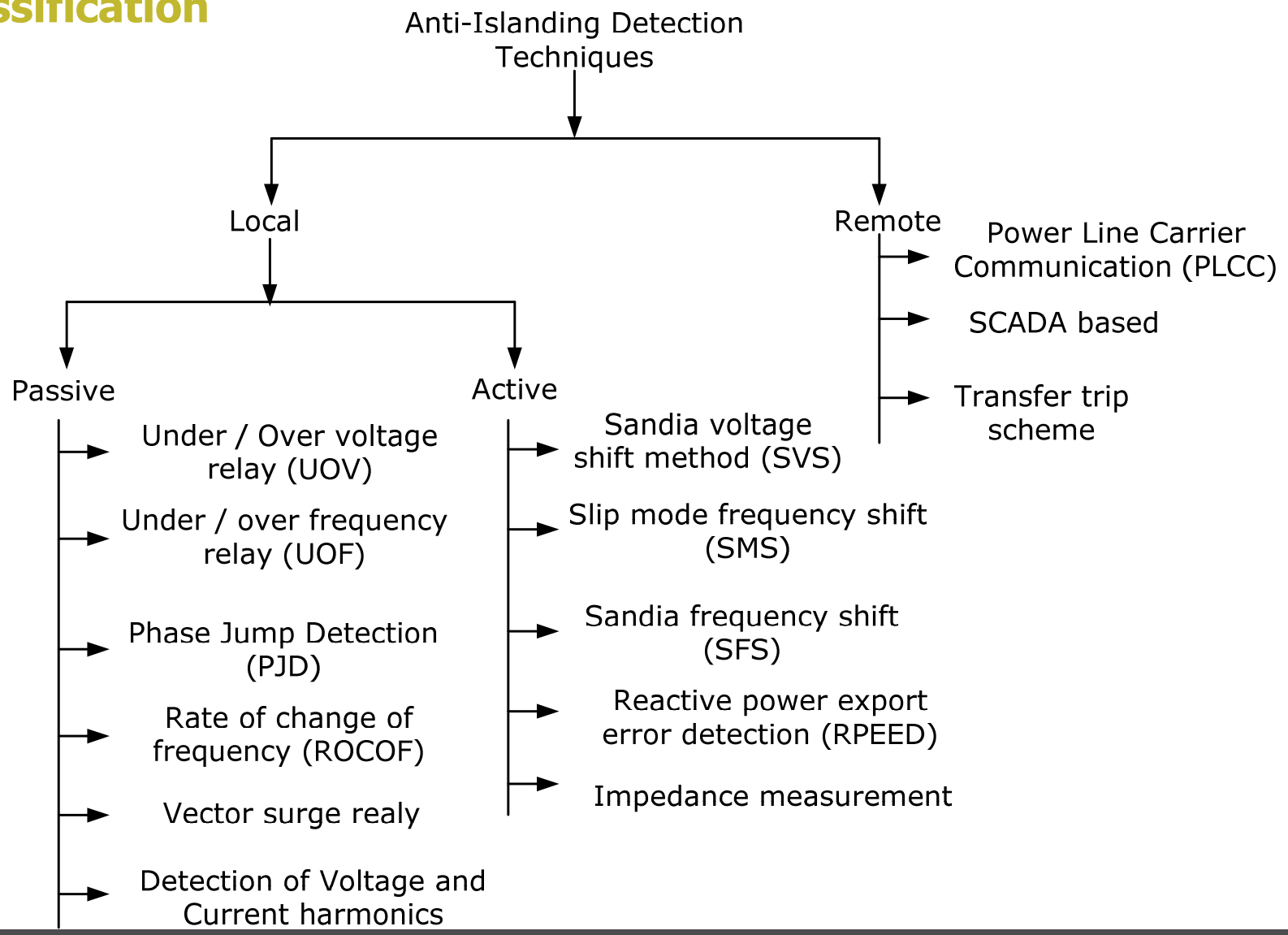
Islanding

Issues

- Danger to maintenance and restoration personnel
- Destruction at both customer and utility side equipment
- Power quality of DG becomes worsen - adversely affect the loads
- Automatic closing of utility breaker may create a condition of asynchronous closure

Anti-Islanding

Classification



Anti-Islanding

Passive and Active Schemes

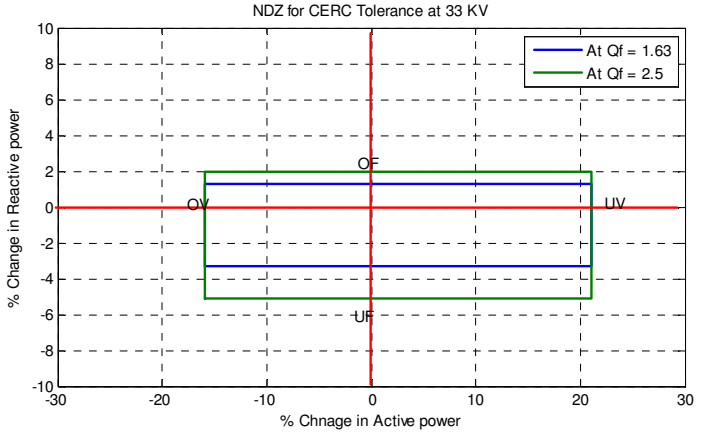
- Passive techniques are based on measurement of instantaneous voltage, frequency and phase deviations at PCC
  - Simple and Easy to implement
  - No introduction of noise or harmonic signal into network as like as Active methods – Power Quality not disturbed
- The range of active power and reactive power change during islanding will influence the detection time
- Passive techniques relay on certain distinct pattern or signatures at the DG out put
- Active techniques introduce deliberate changes or disturbances into the connected circuit and then observe the response

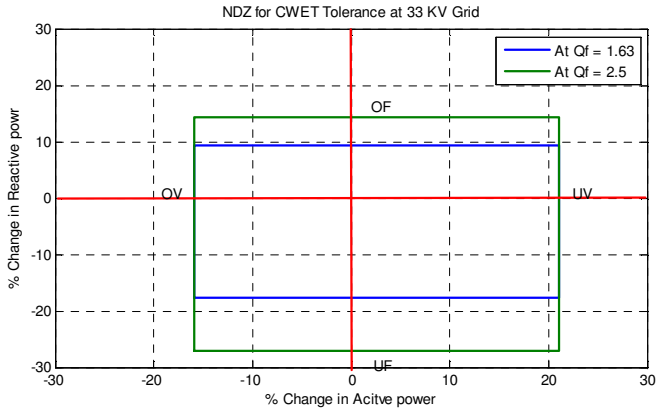
Anti-Islanding

NDZ for CERC and C-WET requirements

- Non Detection Zone (NDZ) is the range active power and reactive power mismatch that causes non detection of Islanding
- In this work NDZ is calculated for CERC and CWET based on voltage and frequency variation allowed

PARAMETER	CERC at 33 KV	CWET at 33 KV
Vmax	36 KV	36 KV
Vmin	30 KV	30 KV
fmax	50.2 Hz	51.5 Hz
fmin	49.5 Hz	47.5 Hz
% change in P	-15.9 % to 21%	-15.9 % to 21%
% change in Q for Qf = 1.63	-3.3% to 1.29 %	-17.6% to 9.35%
% change in Q for Qf = 2.5	-5.07% to 1.98%	-27% to 14.34%

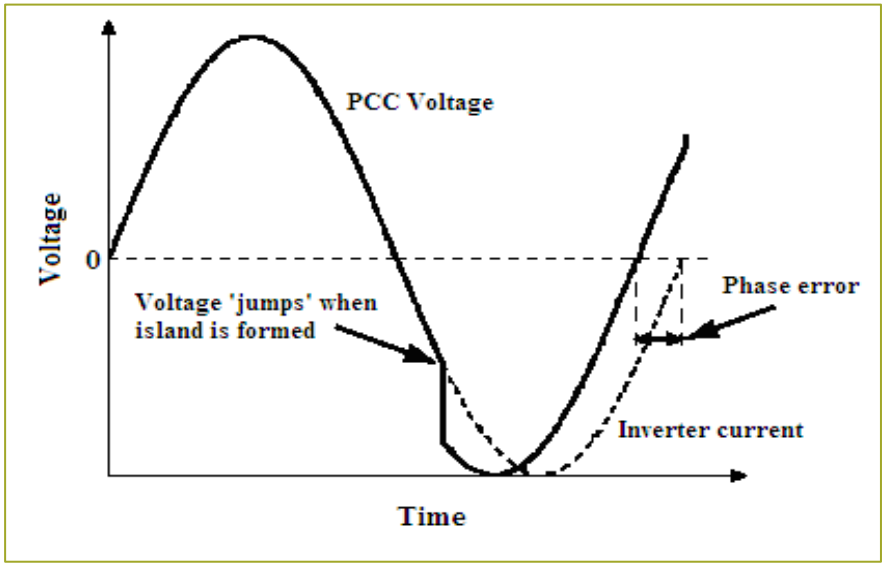




Phase Jump Detection (PJD)

Well known method of Anti-Islanding

- PJD is a passive protection method in which phase angle is computed by using an algorithm, when phase angle is beyond the threshold limit then Islanding is said to be happen
  - This method do not disturb the power quality as like in active methods
  - Easy implementation

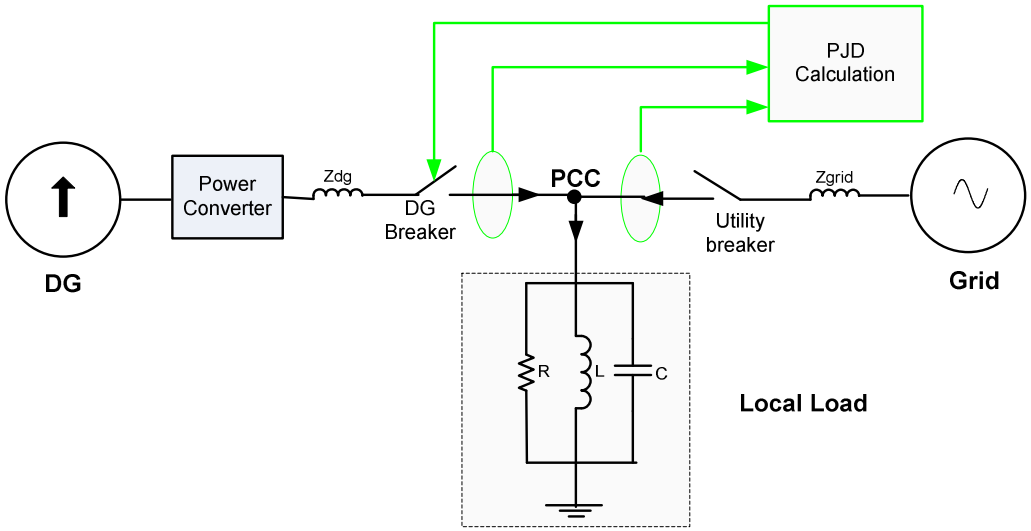


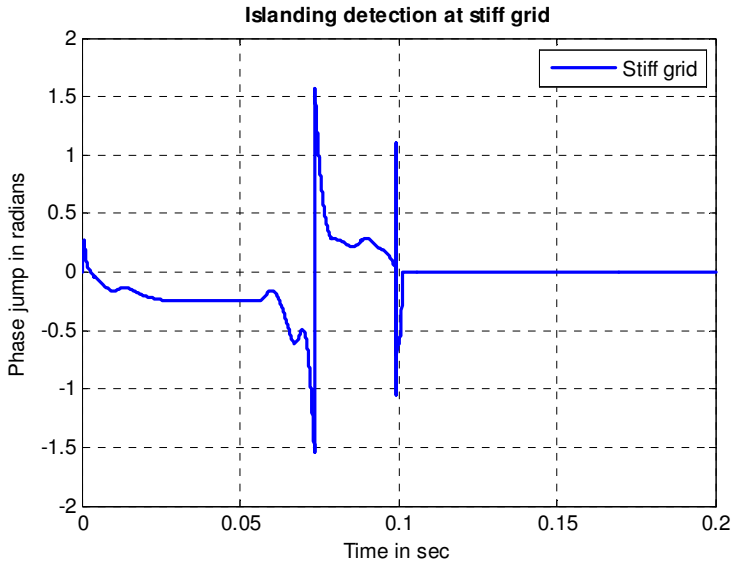
Observes the phase difference between the inverter voltage and current when there is an abrupt jump in the PCC voltage.

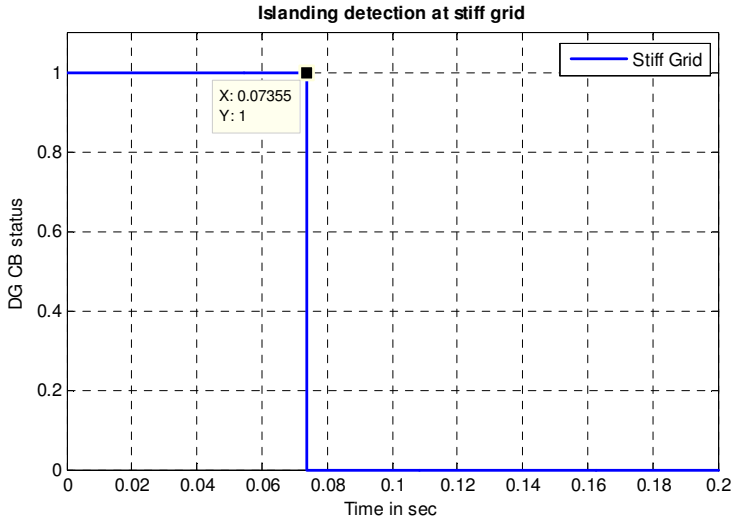
PJD Application

Stiff Grid condition

- MATLAB simulation model is developed to analyse PJD method applied for stiff grid situation
- Islanding detection time for stiff grid is 23.5 msec



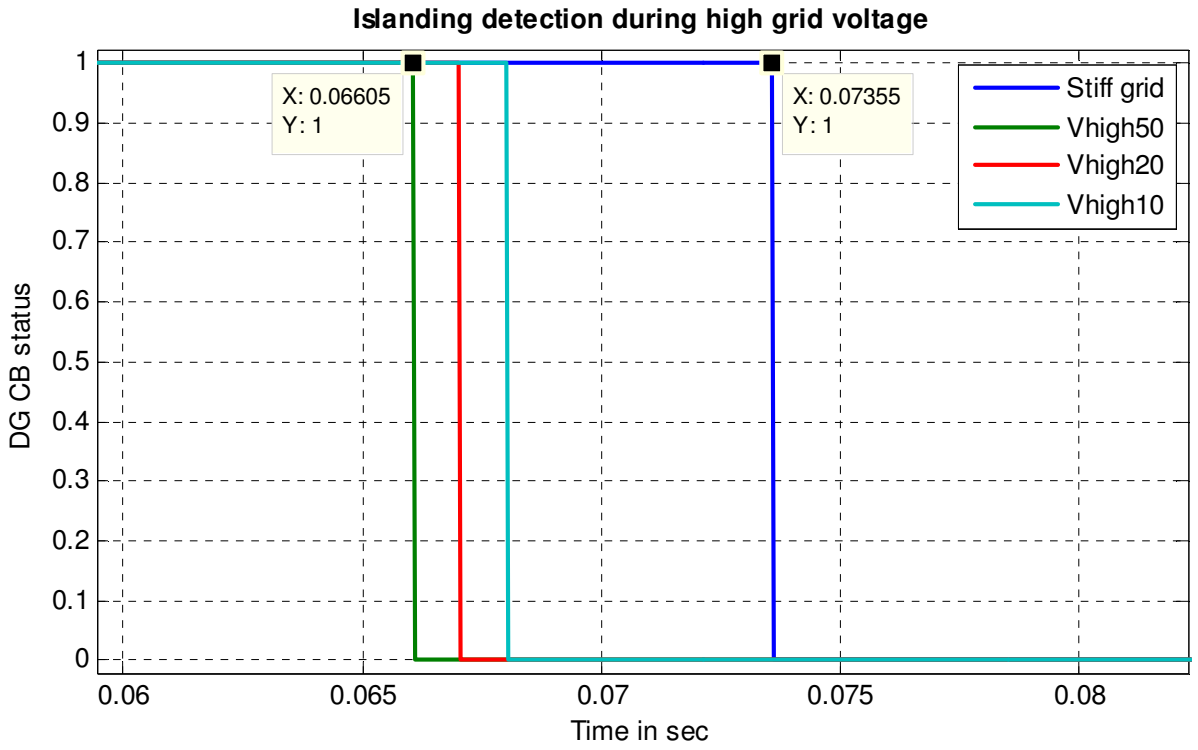




PJD Application

Weak Grid condition – Voltage fluctuations

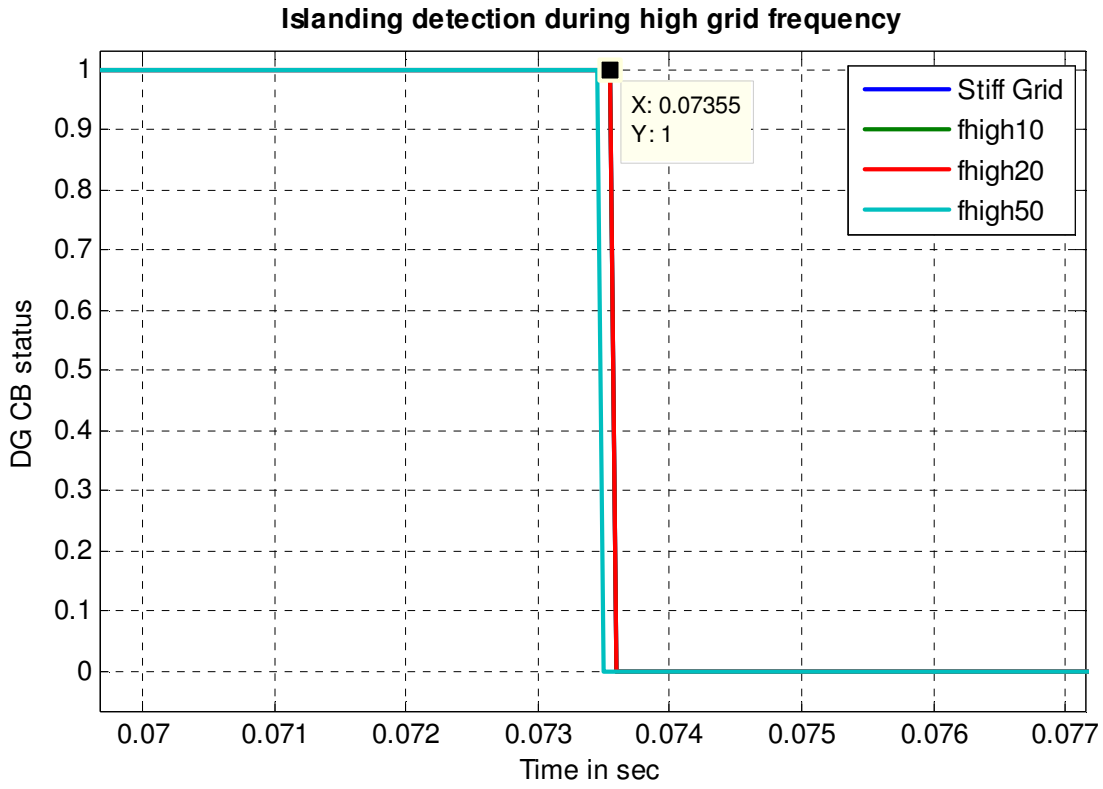
- Same PJD method is applied to various weak grid situations
- Detection time with high voltage fluctuations is 16 msec **- Very QUICK**



PJD Application

Weak Grid condition – Frequency fluctuations

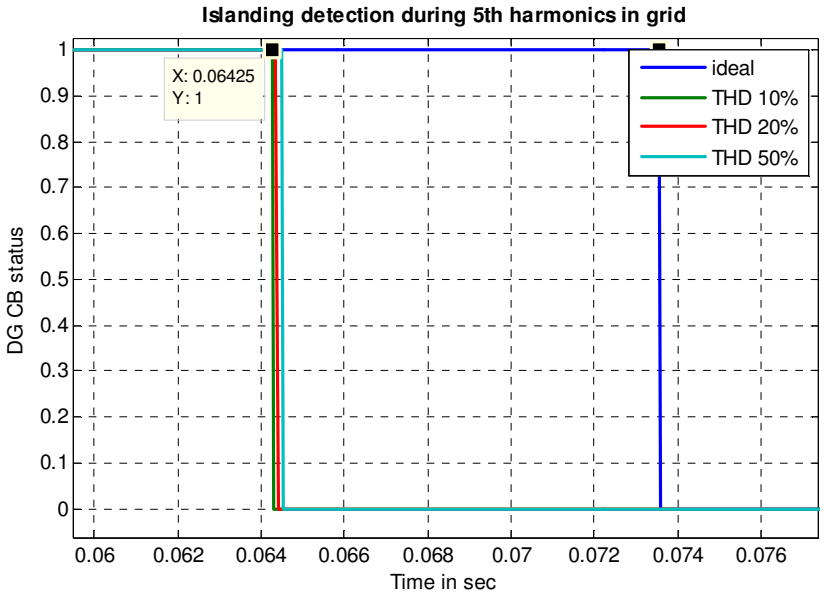
- Detection time same as stiff-grid, effect is negligible **– Because of frequency variation doesn't contribute to phase angale detection**

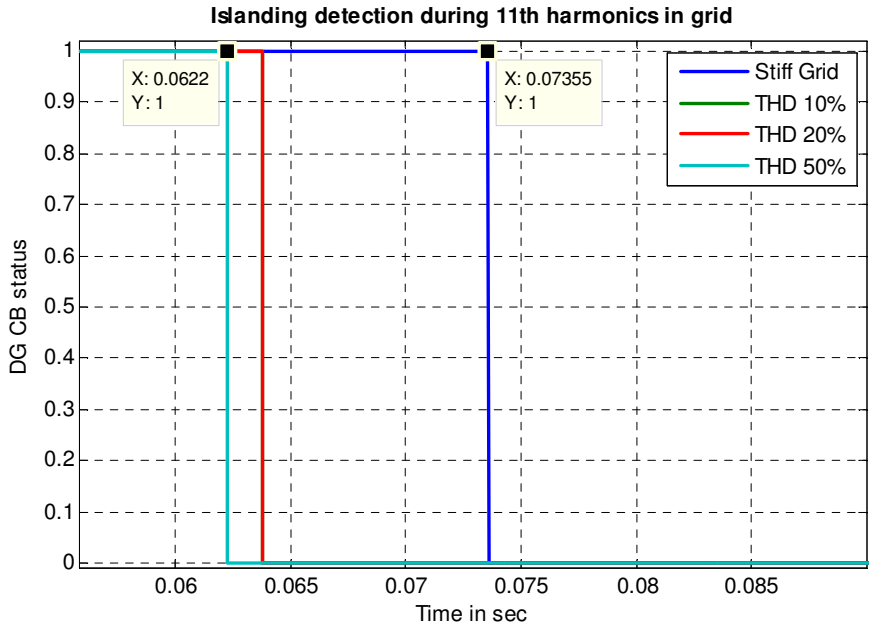


PJD Application

Weak Grid condition – Higher THD presence

- Same Islanding detection as compared to stiff grid due to grid already has harmonics / disturbance
- Detection time with high harmonics in the system is just 14 msec – **Faster detection**





Conclusions

- Introduction to DG Islanding phenomenon
- Need for Islanding protection – stringent Grid codes
- Passive methods are simple, cost effective but higher values of NDZ
- PJD gives early detection of Islanding when grid is weak