Paper 538

Improvement in performance of primary frequency response of generating units in Indian power system

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Presented Ms. Shabari Pramanick, POSOCO, India

Need for Frequency Response

1. 60% of total installed capacity from the renewable power sources by 2030
2. Retirement of old thermal plants
3. Reduction in grid inertia
4. Need for increased frequency control

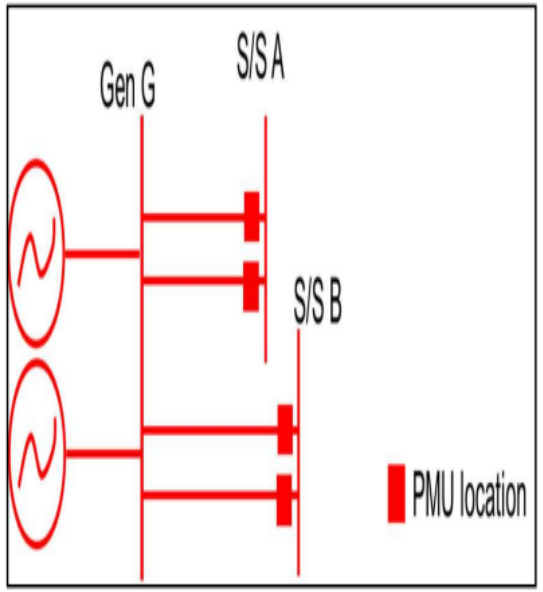
Primary frequency response in Indian power system

Type of generator	Capacity
Coal and Lignite-powered thermal generating units	200 MW & above
Hydro generating units	25 MW & above & with more than 3 hours of pondage
Open Cycle /Combined Cycle generating stations having gas turbines	50 MW & above

Restricted governing Mode of Operation (RGMO) in Indian Power System

- No reduction in generation in case of improvement in grid frequency below 50 Hz
- For any fall in grid frequency, generation from the unit should increase as per generator droop upto a maximum of 5% of the generation subject to ceiling limit of 105% of the MCR of the unit having regard to machine capability.
- Ripple filter of +/- 0.03 Hz to avoid hunting
- Response only in case of sudden rise/fall in the frequency

Evaluation of primary frequency response – SCADA vs PMU



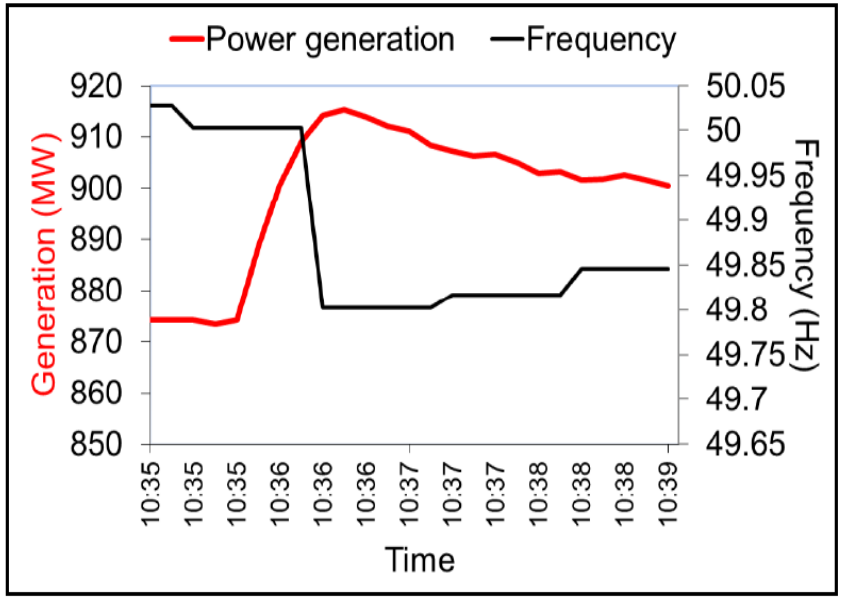


Figure 1:Variation of grid frequency and unit generation captured through SCADA during a grid event

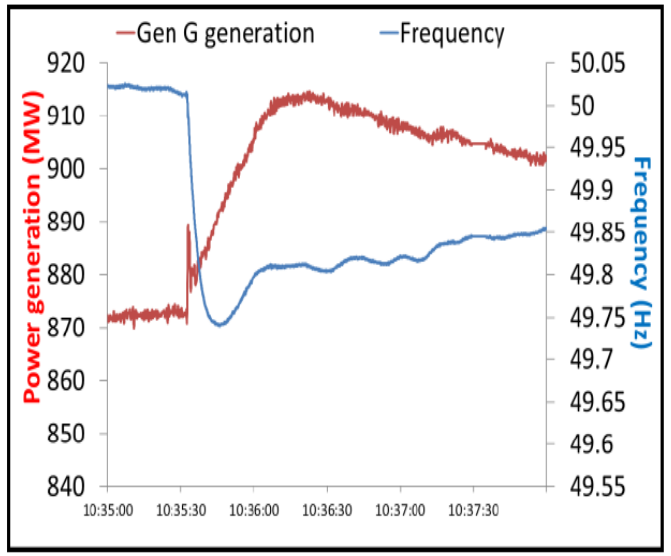


Figure 3: Measurement of power generation at Gen G shown in Figure 2 with the help of PMU at S/S A and S/S B.

Type of unsatisfactory response , reasons & solutions

1. Non-adequate primary frequency response
2. Non sustained primary frequency response
3. Longer time taken to provide full primary frequency response
4. Oscillatory primary frequency response
5. Inability to detect the event of sudden frequency change

Non-adequate primary frequency response

1. Improper droop setting- **correction done as per IEGC**
2. Valve wide open operation of thermal generating units – **generating stations sensitized**
3. Unit generation more than MCR – **necessary instruction to the plants**
4. Old mechanical governing system- **retrofitting**

Non sustained primary frequency response

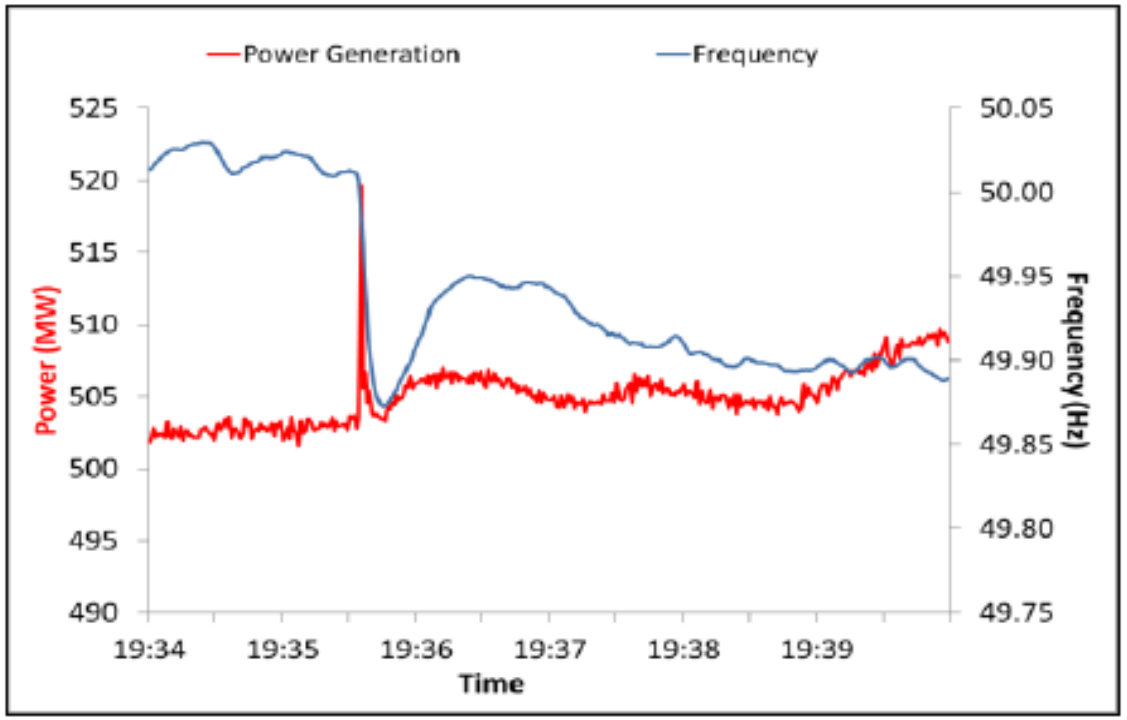


Figure 5: Response of 500 MW generating unit during the event of sudden frequency dip.

1. Insufficient steam pressure
2. Ideal withdrawal of less than 1% of unit capacity
3. **Maintaining of steam pressure & tuning of governor system**

Longer time taken to provide full primary frequency response

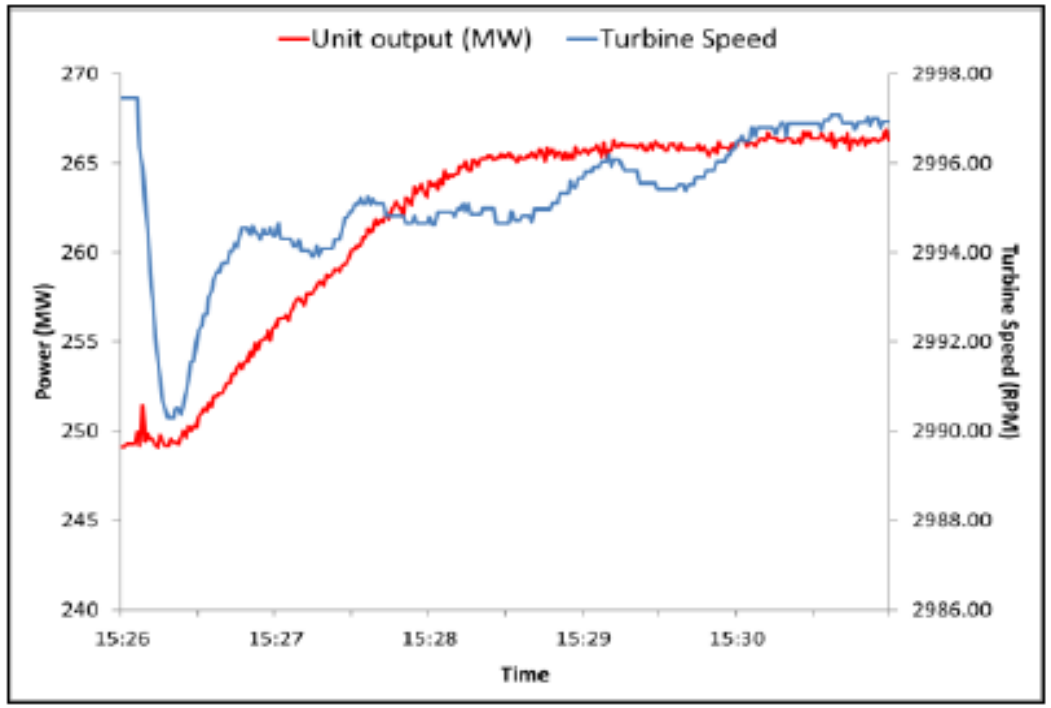


Figure 6: Variation of unit output with turbine speed indicating delayed full response.

1. Improper setting of governor
2. Ideally full response within 30 seconds
3. **Tuning of governor system**

Oscillatory primary frequency response

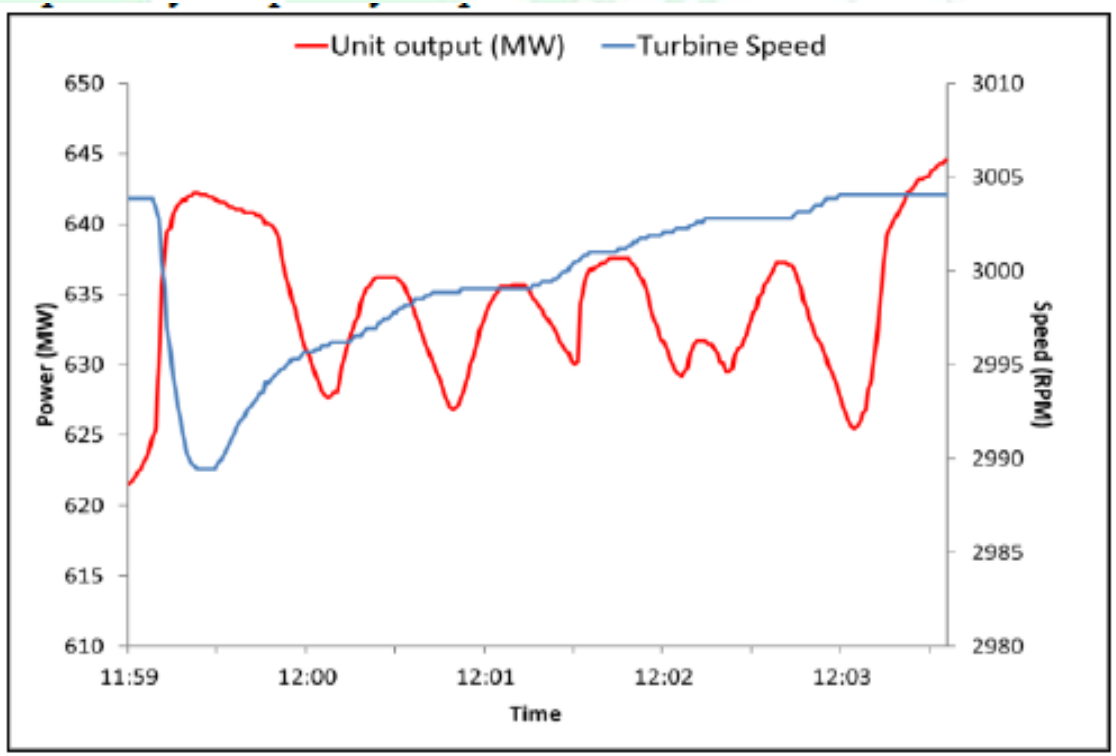


Figure 7: Oscillatory power output from generating units while providing primary frequency response

1. Oscillatory output
2. Controller malfunction
3. **Tuning of governor to prevent hunting**

Technique for RGMO implementation

For detection of sudden frequency change
1.Moving average of system frequency
2. Measuring Rate of change of frequency
For holding the response
1.Soft hold timer logic
2. Sufficient wind pressure

FRC of Indian Grid over the years

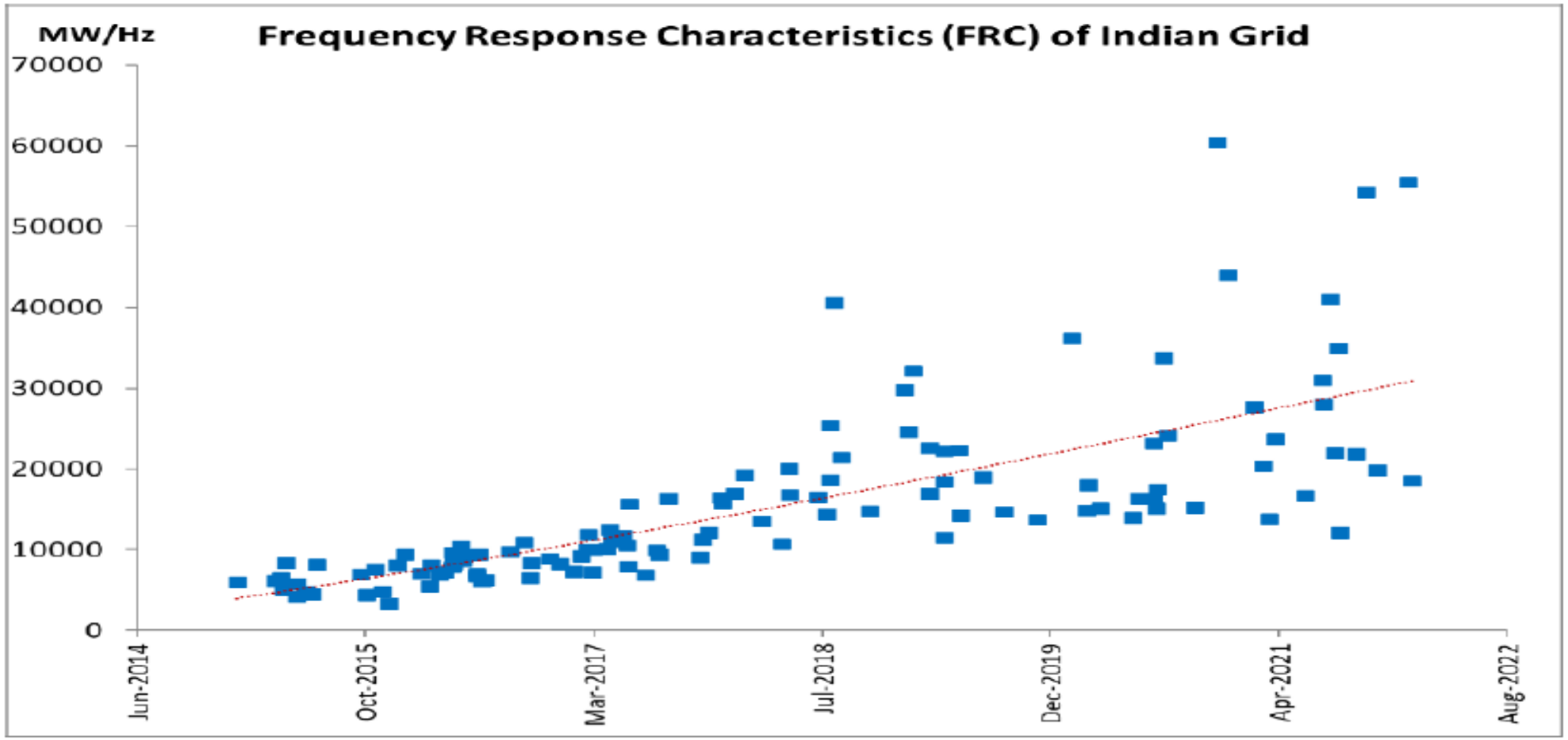
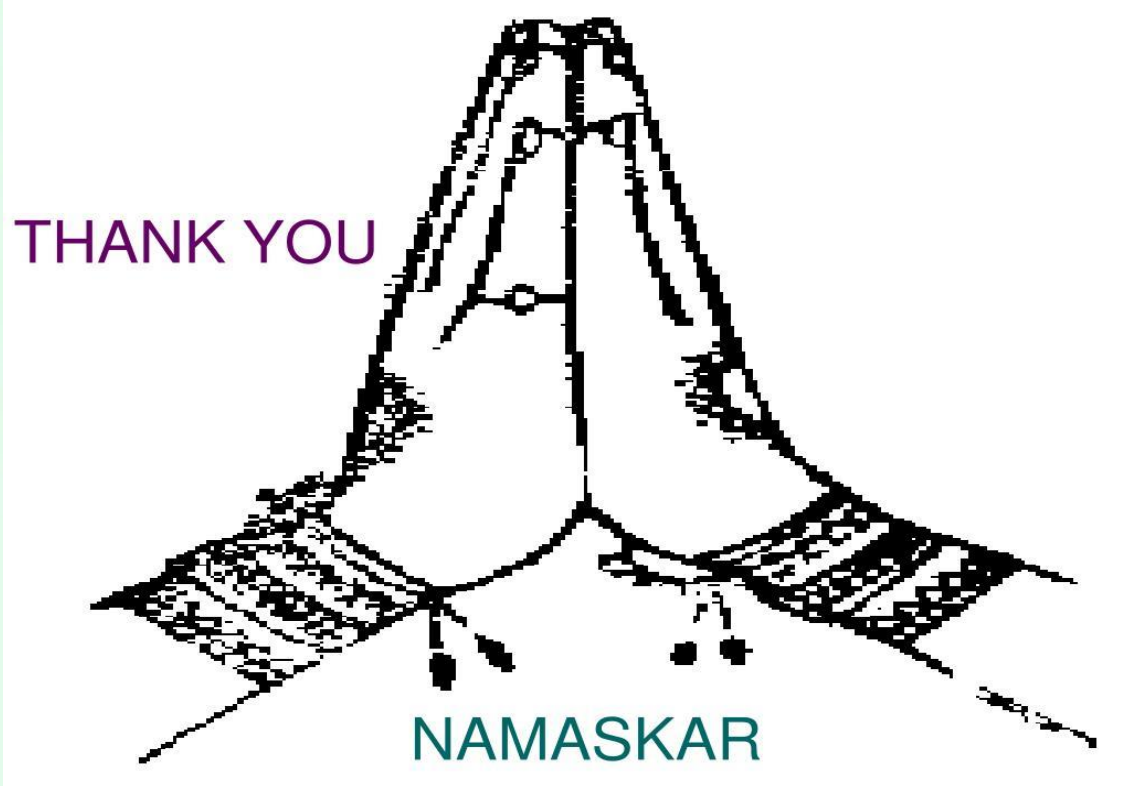


Figure 8: Frequency response characteristics (FRC) of Indian grid

Conclusion

- FRC of Indian grid increase 5 times in last 8 years
- Continuous analysis of challenges faced in PFR implementation
- Feedback and redressal of challenges
- Regulatory measures for mandatory PFR
- PFR testing on periodic basis
- Significant addition of synchronizing machines
- Better frequency profile maintenance in high RE scenario


THANK YOU
NAMASKAR