

Commercial Implications of Renewable Energy Integration in Grid Operation.

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Abstract

This paper highlights the additional Transmission and Generation cost incurred while integrating Renewable Energy to GRID. Underutilization of transmission assets, Operating conventional units in low Plant Load Factor are discussed. Some solutions looking forward to minimize the above commercial implications are discussed.

Index Terms: RGBA-LED, R-OFDM, Discrete Wavelets, Bit error rate

1 INTRODUCTION

This paper deals on additional cost incurred while integrating renewable energy to GRID.

They are

1. Transmission Cost
2. Generation Cost

1. Transmission Cost:

It involves asset requirement and STATCOM devices used to compensate reactive power.

2. Generation Cost:

It involves balancing the power requirement, generated from conventional sources to compensate the variable power generated on Renewable Energy.

2 ADDITIONAL TRANSMISSION COST OF INTEGRATING RENEWABLE ENERGY

- A conventional source with same evacuation capacity with 80% of plant load factor against 25% plant load factor of RE can transmit 3 times more energy.
- Calculation at 10 paisa/unit as transmission charge for conventional sources (35,000 mu) works out as increase in transmission charge of around 20 paisa/unit for evacuating RE of 10,000 mu.
- Cost of STATCOM to control voltages during variable generation resulting different line loading. 200 MVAR STATCOM cost 200 crore.
- This would also require implication of fixed charge associated with the on bar generation not utilized.
- The capacity of generation not getting utilized to accommodate RE generation is again on the percentage of RE integration in a control area with whom PPA is signed.
- The cost works out to be around 20 paisa/unit with generation variation from 5000 MW to 2000 MW

Generation On Bar To Accommodate Variation In RE From Forecasted Value.

- The capacity to accommodate error up to 15% as per RE forecast regulation for 8000 MW installed capacity would be 1200 MW.

- To keep a margin of 1000 MW in thermal station would incur additional charge of 20 paisa/unit.
- This would depend on the accuracy of forecast.
- The charges of deviation vs PPA rates also would have commercial implication up to 250 MW for a RE state
- The cost computed is based on assumptions considering a control area of 15,000 MW capacity having RE of 5000 to 6000 MW. With RE generation for 6 months and variation from 2000 MW to 5000 MW.
- The RE integration is of 33%. This could have additional burden of 1.1 to 1.5 rupees/unit of RE generated.

3 ADDITIONAL GENERATION COST OF INTEGRATING RE BALANC- ING POWER REQUIREMENT FOR ABSORBING RE.

1. The capacity off bar to be called when generation from RE is not available.
2. The capacity on bar running units on sub optimal level to supplement RE ramp rates, backing down during high RE generation and increase generation with low RE generation.
3. Generation on bar to accommodate variation in RE from forecasted value.

The Capacity Off Bar To Be Called When Generation From RE Is Not Available.

- The capacity in MW to be kept off bar during RE generation season and to be brought back after RE season end, depends on the minimum generation anticipated from RE source.
- Considering 2000 MW as generation to be kept off bar during RE season of 6 months (April to September) with fixed cost

of rupees 1 per/unit, but for evacuating 10,000 MUS of RE would incur additional cost around 50 paisa/unit.

- The additional cost is not based on the percentage of total RE integration in the connected grid but depends on the percentage of RE integration in a control area with whom PPA (power purchase agreement) is signed.

The Capacity On Bar Running On Sub Optimal Level

- The capacity running at level below 85% PLF to accommodate ramp rates of RE and manage maximum and minimum generation from RE.
- There could be additional increase in energy charge rate for a thermal station to generate at 75-65% PLF against 85%.
- The additional charges for evacuation 10,000 MUS of RE may be around 7 paisa/unit.

Tamil Nadu Summary (Case Study)		
1.	Total balancing charge for CGS(Central Generating Station) Coal and gas based station (fixed +fuel charge)(Rs/kWh)-Spread over renewable generation	0.20
2.	Total balancing charge for Tamil Nadu Coal based station (fixed +fuel charge)(Rs/kWh)-Spread over renewable generation	0.03
3.	Impact of DSM(Deviation Settlement Mechanism) per unit- Spread over renewable generation	0.35
4.	Impact on tariff (Rs./Unit) for Tamilnadu discom for backing down Coal generation assuming solar and wind at Rs. 4/kWh and coal fuel charge at Rs. 2.0/kWh- Spread over renewable generation (Considering 25% on account of renewables)	0.50
5.	Stand by charge (Rs/kWh)- Spread over renewable generation	0.23
6.	Extra transmission charge (Rs/kWh)- Spread over renewable generation	0.26
Total Impact - spread over renewable generation (Rs/kWh)		1.57

Calculation for All India scenario for 2022 is Rs.1.11/Kwh

4 SOLUTION:

Sale of RE power in real time power market. Fulfilling Renewable Purchase obligations. Cost of integration reduces with the ratio of RE vs Conventional source is low. In order to see that balancing is done in the most optimum manner, resulting in least cost to Discoms and hence to consumers, it would be best to balance the variations from renewable generation with gas and hydro generation rather with coal based thermal stations.

References

Report Of The Technical Committee On Study Of Optimal Location Of Various Types Of Balancing Energy Sources/Energy Storage Devices To Facilitate Grid Integration Of Renewable Energy Sources And Associated Issues. (CEA/MOP Dec2017).