Comparative study on Unscheduled Interchange of South Indian States

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Abstract— The Availability Based Tariff mechanism has been introduced in Electricity Act 2003, mainly to achieve grid discipline and improve power sector performance. One of the main component of ABT is the Unscheduled Interchange charge that acts as a mechanism for regulating the grid frequency. At the same time, this mechanism offers opportunity for third parties to buy and sell power through the national grid. Based on under/over drawal of power from the beneficiary, incentives/penalties are given to the beneficiary. Likewise, under/over generation from the producers with respect to the scheduled power, generators are penalized/rewarded accordingly. This paper makes a comparative study on the deviation from scheduled energy and the UI rates of south Indian states like Karnataka, Tamilnadu and Andhra Pradesh from 2012 to 2014.

Key words: Andhra Pradesh (AP), Availability Based Tariff (ABT), Central Electricity Regulatory Commission (CERC), Indian Electricity Grid Code (IEGC), Karnataka (KA), Power Exchange, Real time Balancing, Tamilnadu (TN), Unscheduled Interchange(UI)

I. INTRODUCTION

A major share of power generation in India comes from Thermal sources. Most of the generation is owned by the State government and another portion is owned by the Central government. There are also small percentage of private producers [1]. Until the 2003 act, importance was given more for capacity addition than maintaining grid discipline. This used to create a havoc in the power system, dip in operating frequency, Voltage fluctuation and outages were quite common. Prior problem in the Indian power sector was not only the shortage of power but also the difficulty in performing grid operations due to acute indiscipline shown by the generators as well as the beneficiaries. The incentives to the generator were linked to actual generator and not on availability. The generators could pump as much power in the grid as they could irrespective of the frequencies and still get acknowledged for the wastage of the valuable resource. The regional grid operators ironically had a horrifying time trying to get generators backed down to protect the turbines of the same generator causing the situation. On the other end the state utilities could overdraw from the grid even during deficit, creating a chaos and despair all around and still escape from consequences [2-3]. Stable operation of the interconnected power system, requires that frequency be maintained within a certain tolerance as defined by the standards adopted in a country. Availability Based Tariff was introduced to have a new tariff structure based on frequency deviation to bring accountability by the stake holders through rewards and penalties. This scheme helped bring down the rate of power outages, load-shedding and disintegration. In case the average availability achieved is lower, the payment is also lower, thus the name 'Availability Tariff'. The frequency of the system is improving every year. The nominal operating frequency is 50 Hz and the permissible frequency band specified by IEGC has been revised from 49.5 Hz to 50.2 Hz from May 2010. Frequency fluctuations on daily basis of the southern grid is as shown in Figure 1. Tightening the frequency band, improves the security and the efficiency gain.

II. TARIFF COMPONENTS

The Availability Tariff, particularly is a rational tariff structure for power supply from generating stations, on a contracted basis. The power plants have fixed and variable costs. The ABT has three component charges and each of them has its own importance in this scheme. They are capacity charges, Variable charges and UI charges [4].

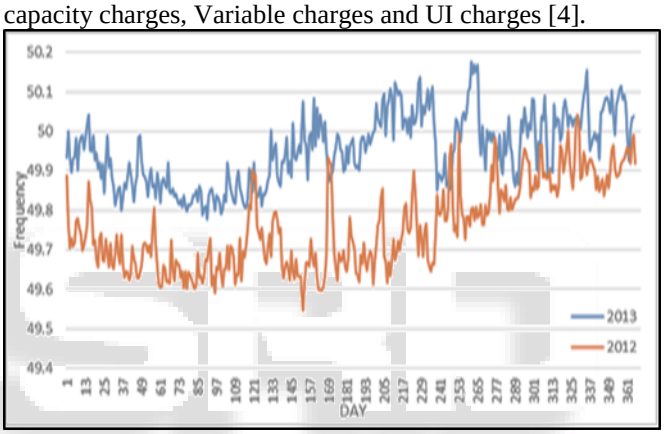


Fig. 1: Frequency Variation in Southern Grid for the year 2012 and 2013

A. *Capacity Charges:*

These charges are payable to the generating station, towards reimbursement of the fixed cost of the plant, linked to the plant's declared capacity to supply MWs by the beneficiary and they do not depend on the actual energy drawn from the generating station.

B. *Energy Or Variable Charges:*

Variable charges are paid against the actual energy drawn from the generating station by the beneficiary.

C. *UI Charges:*

These are paid whenever there is a deviation in the energy drawn from the scheduled value. In simple words, if a generator generates more/less than the scheduled value OR if a beneficiary draws more/less than the scheduled value, causing the grid frequency to increase/decrease. Penalty has to be paid which is directly proportional to frequency deviation. The relationship between the tariff and the grid frequency is decided by CERC [5-6]. The energy is metered in 15 minute blocks to keep track of changing frequency and to make this scheme dispute-free and judicious for both seller and buyer. The UI rate is determined by taking the average frequency for the time block and comparing with the scheduled value. There will always be a deviation from

the scheduled value, both the beneficiary and the producer are encouraged to stick to the scheduled value through this scheme.

"Zero UI is a coincidence rather than expectation"- North Electricity Reliability Council, Joint Inadvertent Interchange Task Force Report, May 2002 [7].

III. GRAPHS AND UI COMPARISIONS

Deviation from the scheduled energy in MWhr and the corresponding UI rates (weighted average for that month) were tabulated and graphs were plotted accordingly for the 3 states, AP, KA and TN from 2012 to 2014.

In year 2012, Karnataka has fared way better than other states in terms of UI. This can be due to surplus generation in the state resulting in lesser drawal of energy from the grid. The variation of the state(s) UI rates and UI energy drawal is represented on a graph [Figure 2].

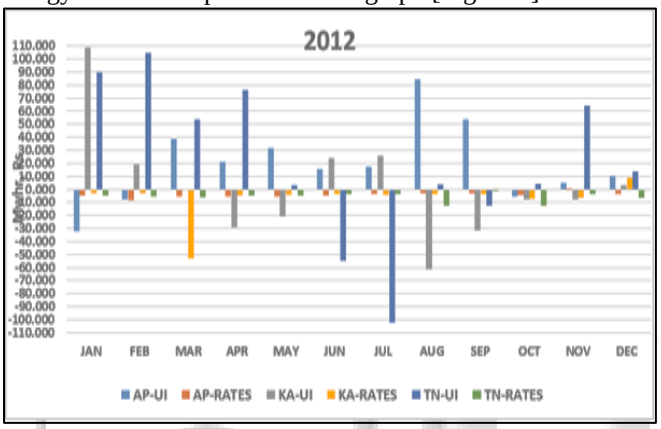


Fig. 2: Comparison graph for the year 2012. (UI Energy – MWhr, UI Rates – Rupees)

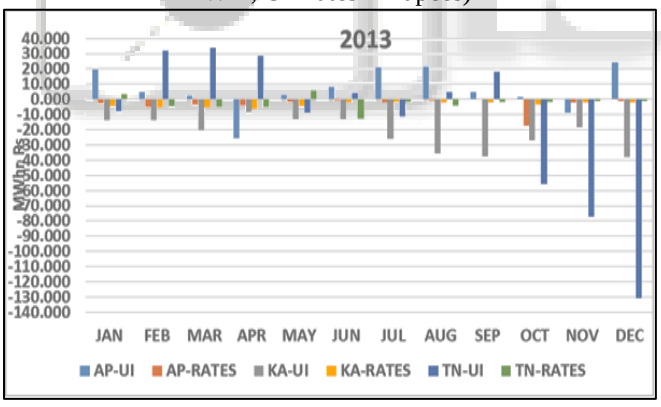


Fig. 3: Comparison graph for the year 2013. (UI Energy – MWhr, UI Rates – Rupees)

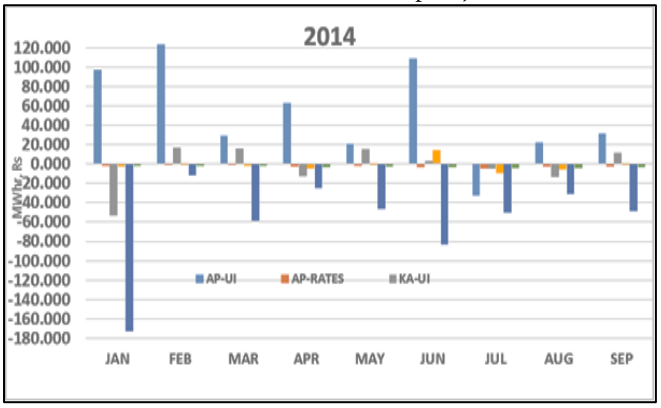
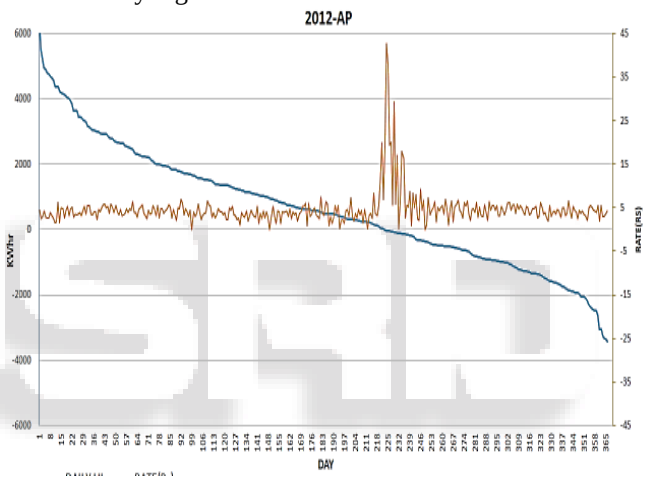


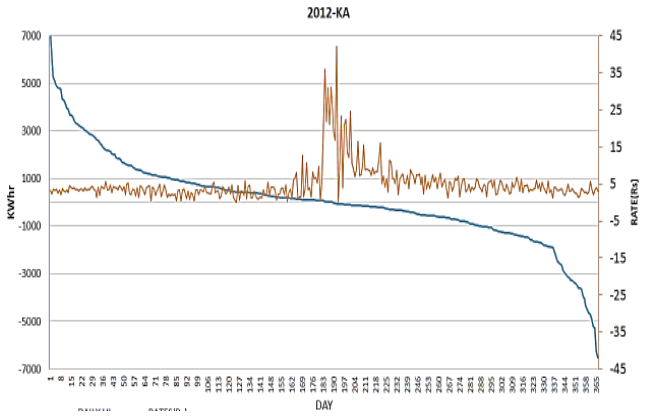
Fig. 4: Comparison graph for the year 2014. (UI Energy – MWhr, UI Rates – Rupees)

In year 2013, Karnataka and Tamilnadu have generated and supplied energy into the grid, It can also be noted that only Karnataka was rewarded and other states were penalized for over drawal of energy from the grid. The variation of the state(s) UI rates and UI energy drawal is represented on a graph [Figure 3]. There are many Improvements brought about by UI mechanism like, grid frequency has drastically reduced from 48 to 52 Hz earlier to 49.4 to 50.2 Hz for most hours in a day, the hydro electric utilities are handled in an efficient manner than it was done before, power deficit states can meet their occasional excess demand by over drawing from the grid and paying the UI charges to the state which has under drawn.

IV. UI VARIATION WITH CORRESPONDING RATES

The variation of UI Energy in kWhr and their corresponding Rates in Rupees when plotted with descending order of UI energy are recorded. It is vital to maintain the UI when the rates are very high.





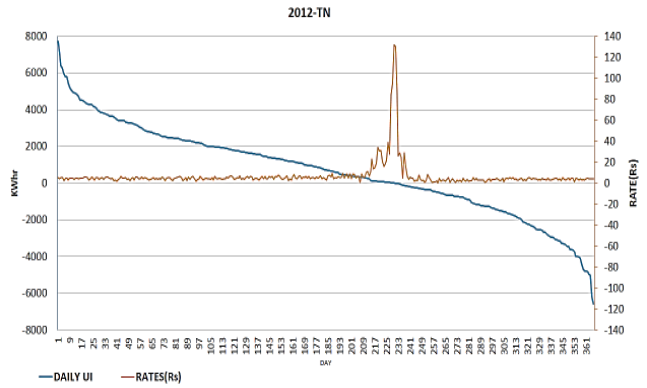
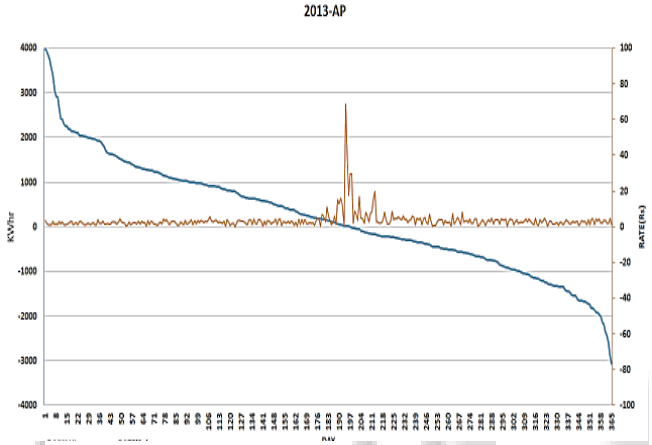
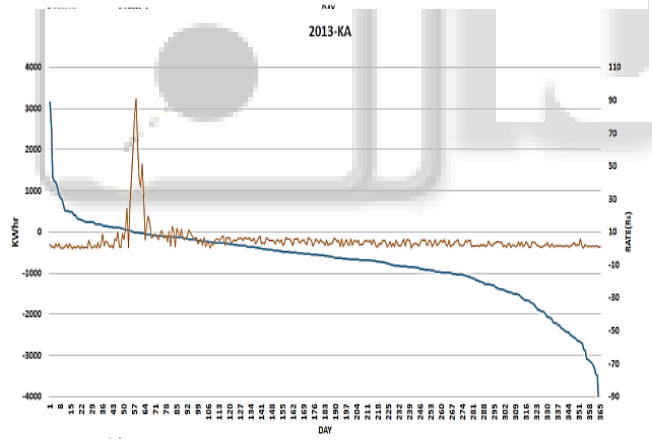


Figure 5. Variation of UI Energy and corresponding rate when arranged in descending order w.r.t UI energy for the year 2012





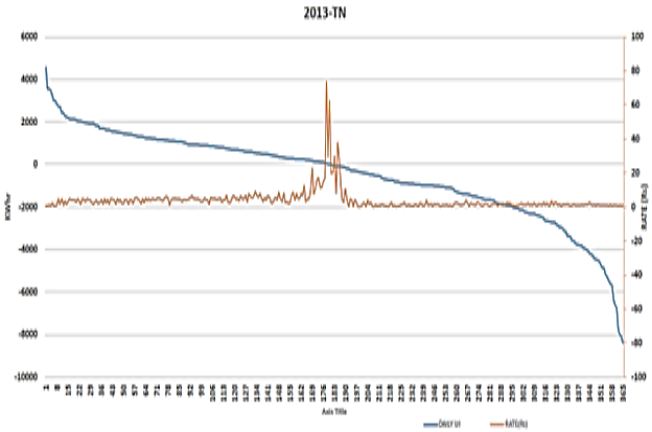
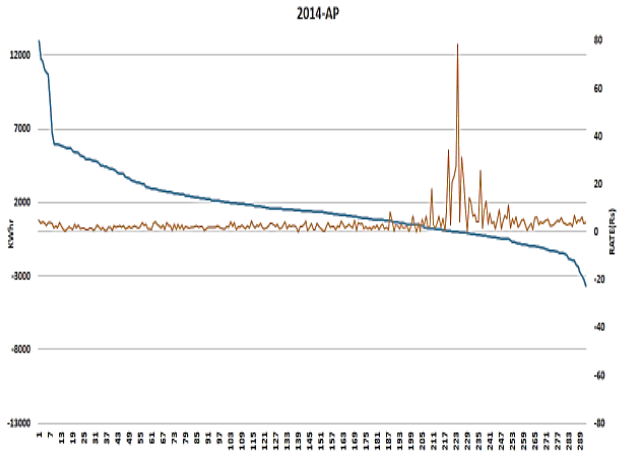
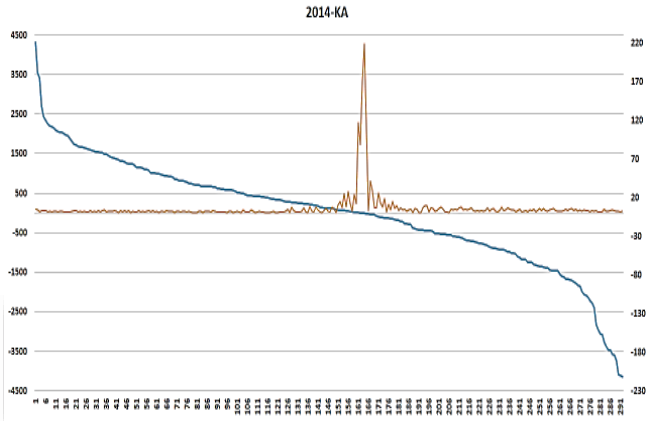


Fig. 6: Variation of UI Energy and corresponding rate when arranged in descending order w.r.t UI energy for the year 2013





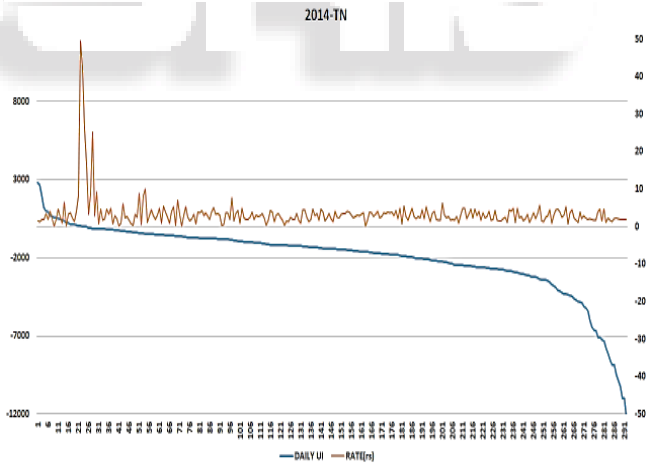


Fig. 7: Variation of UI Energy and corresponding rate when arranged in descending order w.r.t UI energy for the year 2014

V. CONCLUSION

Every state has two options, one is to generate energy from state owned plants or draw energy from the regional grid. If the state draws from the regional grid, it has to pay the prevailing rate per MW [8-9]. Now, if the UI rate is lower than its own marginal cost of generation per MW, then it would be advantageous for the state to back down its own generation and draw from the grid. If the frequency falls because of reduced generation, the UI rate would go up, forcing the state to increase its own generation. This would

continue till the state achieves a state of equilibrium, i.e. when generation of the state equals the prevailing UI rate. The other is when the UI rate is higher than the marginal cost of generating plants of the state, then the state would reduce the energy drawn from the grid and increase its own generation. The frequency would tend to rise and UI rate would decline, this is done until the state of equilibrium is achieved. Hence, over-drawal and under-drawal of energy is very common and is clearly indicated in the graphs. It can be clearly seen that all the states have significantly decreased drawing energy from the grid and except for AP, other states have under drawn quite significantly, which indicates surplus power generation within the state. The increase in frequency stability proves that the UI mechanism is an excellent approach for overall improvement of the Indian power sector.

VI. ACKNOWLEDGEMENT

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