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## Implementation of ABT (Availability Based Tariff) - its Treatment & Proceedings

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### ABSTRACT

*This paper gives an insight into the various aspects of ABT and its implementation. It covers the salient features of ABT, requirement for day ahead, real time scheduling and operation in ABT Regime. Also the concerns regarding implementation of ABT and the impact on various industry players is being dealt with. The implementation of ABT though complex, shall bring about an immense improvement in grid discipline.*

**Keywords : ABT (Availability Based Tariff), Real Time Scheduling**

### I. Introduction

The electricity industry in India is facing a lot of challenges. They range from inadequate capacities in generation, transmission, and distribution, outdated technologies especially in T&D, poor maintenance, financial constraints, etc. As per the Regulatory Commissions Act 1998, the Central Electricity Regulatory Commission (CERC) is authorized to regulate bulk electric power tariffs, viz. the tariff for generation and transmission of power. This will promote competition thereby improving operational efficiency and safeguarding consumer interests. The ABT mechanism is based on the financial principals, wherein all the Central Sector generators and beneficiaries (i.e., various States) must declare a schedule for generation and drawal for every 15 minutes one day in advance. Any deviation from the schedule is charged at the rates, which are frequency dependent.

Previously, before implementation of ABT, there was frequent problem of power overdrawal from one of the State beneficiaries, leading to the grid instability. But the new frequency based tariff has brought lot of grid discipline. Still this inter-State ABT is a partial solution of the problem because currently there is a huge amount of peak power shortage experienced by majority of the State utilities. In addition to this the transmission corridors are getting congested while bringing the excess amount of power from the remote location to the load centers.

Availability means the readiness of the generating station to deliver Ex. Bus output expressed as a percentage of its rated Ex. Bus output capability as per rated capacity. The term availability in the present context could be defined as the MW capability of the generator for supplying to the grid after accounting for the planned and unplanned outages and deration due to non-availability of auxiliaries, fuel and water.

$$\text{Availability} = \frac{\text{Summation of DC over the Day} \times 100}{\text{DC corresponding to Rating}}$$

$$\text{PLF} = \frac{\text{Generation for the Period} \times 1000 \times 100}{\text{MW} \times \text{No. of hours in the period}}$$

The predecessor was Two part tariff (K P Rao formula) that was applicable for central generating stations, wherein there was no inbuilt mechanism for frequency control. K P Rao Tariff did not seem to encourage grid discipline as there were conflicting commercial interest in the tariff structure- SEBs/CGs, absence of peak off-peak tariff and lack of TOD metering.

The possible remedies thought were Incentivize generation so that generators are available for scheduling and despatch, particularly during peak hours, Incentivize generators to back down during off- peak hours, Load curtailment during low frequency, Independent pool operator for scheduling, monitoring, documentation, system operation etc. & Penalties for deviation.

The central government had been examining the reform of the tariff structure of bulk power with objective:

- ◆ Inducing better system operation and grid discipline
- ◆ Through commercial incentives and dis-incentives.

### II. CONCERNS ON ABT

While ABT is acknowledged to be a welcome measure to tackle the major problems in our power scenario and is expected to be the welcome step towards a self-regulating market, there are a lot of concerns that need to be addressed by this new system. We will, in this document, concern ourselves only with issues of a technical nature and not with those having political or statutory implications (such as whether a particular clause of ABT is within the jurisdiction of CERC). For information regarding these and detailed information on the clauses of ABT, the reader is referred to the full text of the ABT notification. Some of the important technical concerns to be addressed by ABT are:

- ◆ What happens to the schedule and UI charges in instances of the grid disruption beyond the control of generator or consume? ABT delegates the responsibility of resolving such instances to the RLDC. However more clarity needs to be brought forth on this issue as this point can potentially cause a lot of contention regarding the UI charges.
- ◆ A fundamental concern on ABT is whether it is the right measure to be introduced. While the spirit and intention of the act is widely appreciated, there is serious concern that it introduces elaborate and complicated procedures that shall give rise to a lot of contentions between involved parties on their interpretation. Some of these aspects include the declaration and demonstration of availability by a generating station, computation of variable and UI charges, rescheduling of generation and consumption etc. It may be required to evolve the current proposals to a more simplified and transparent system over a period of time.
- ◆ Acceptable availability may vary depending on the energy

source of the generating station. And in some cases, such as hydro and wind stations the availability may not be accurately predictable except in the very short term. This will pose problems in calculation of fixed charges based on availability

- ◆ Plants commissioned in different times tend to use vastly varying technology and thus tend to differ a lot in efficiency and cost of production. Since revenue for the generator vary significantly with efficient and controlled operation, old (though fully functional) plants may be at a disadvantage. The investment required to bring them to par with their modern counterparts may not be justified by the professed returns. On the other hand if CERC relents to discriminate between plants based on this factor, it will just add to the opacity of the proposed System
- ◆ Another significant concern on ABT is the possibility of gaming (deliberate manipulation of availability, daily demand and capacity schedules etc.) by the involved parties to derive undue benefit from the UI charges. ABT system introduces clauses meant to discourage gaming through severe penalties. Whether this will prove a sufficient enough deterrent and whether the checks and balances prove adequate to detect gaming need to be ascertained
- ◆ Another interesting concern is the CERC that any revision in schedule by the RLDC will deemed to be effective irrespective of the successful communication of the same to concerned parties. As has already been pointed out, most of the concerned parties being PSUs lagging on the technology front are yet to have fool-proof or redundant communication infrastructure in place. Thus rescheduling may fail to reach concerned parties in a timely manner and if somebody is caught unawares on the wrong side of the UI charges, they are not going to be pleased about ABT.

### III. SALIENT FEATURES OF SCHEDULING

#### A. Scheduling Terminology

- ◆ IEGC: Indian Electricity Grid Code
- ◆ ISGS: Inter-state Generating Stations
- ◆ RLDC: Regional Load Dispatch Centre
- ◆ SLDC: State Load Dispatch Centre
- ◆ Firm power: upto entitlement
- ◆ Entitlement: varies with declared capability. Maximum of allocated share at 100% dc.
- ◆ Infirm power: unrequisioned surplus power & ui.
- ◆ Priority in scheduling & accounting:
  - a. Firm power
  - b. Bilateral power
  - c. Infirm power-UI

#### B. Scheduling Responsibilities

- ◆ Generators:
  - a. Communication of Day-ahead capability (DC)
  - b. Communication of revision of capabilities
  - c. Adherence to IEGC and directions of LDCs
- ◆ Load Dispatch Centres:
  - a. Preparation and communication of Schedules
  - b. Keeping Accounts of Energy
  - c. Instructions w.r.t. Real time operation
  - d. Frequency Management
  - e. Network Congestion
- ◆ Jurisdiction:
  - a. Regional Load Dispatch Centre :
    - o Inter-state CGS
    - o UMPPs
    - o Inter-state Bilateral transactions
  - b. For all private ISGS of size >500 MW where at least 50% power is allocated outside the home

state

- ◆ State Load Dispatch Centre :
  - a. Intra-state generators
  - b. IPPs except those above
  - c. Embedded Open Access customers

#### C. Day-Ahead Scheduling

- ◆ Declaration of station-wise capability by ISGS: 09:00 hrs.
- ◆ Advice on entitlements of constituents by RLDC: 1000 hrs.
- ◆ Drawal requisitions and bilateral exchanges by SLDCS to RLDC: 1500 hrs.
- ◆ Announcement of surplus: Dispatch & drawal schedule (1st draft) to each constituent: 1800 hrs.
- ◆ SLDCS/ ISGS may inform changes to their capability/ drawal: 2200 hrs.
- ◆ Final day-ahead schedule: 2300 hrs.

#### D. Real Time Scheduling

##### ◆ Provisions In ABT Order

- a. Capability Revision Due To Tripping: "In case of forced outage of a unit, RLDC will revise the schedules on the basis of revised declared capability. The revised schedules will become effective from the 4th time block, counting the time block in which the revision is advised by the generator to be the first one. The revised DC will also become effective from the 4th time block."
- b. Revision of Capability/ Requisition: "permitted with advance notice. Revised schedules/declared capability in such cases shall become effective from the 6th time block, counting the time block in which the request for revision has been received in RLDC to be the first one."
- c. Schedule Revision Due To Transmission Constraints: "(As certified by RLDC) necessitating reduction in generation, bottleneck in evacuation of power has taken place to be the first one. Also, during the first, second and third time blocks of such an event, the scheduled generation of the station will be deemed to have been revised to be equal to actual generation and also the scheduled drawals of the beneficiaries will be deemed to have been revised to be equal to their actual drawals."
- d. Schedule Revision Due To Grid Disturbances: "Scheduled Generation of all the Generating Stations and Scheduled Drawal of all the Beneficiaries shall be deemed to have been revised to be equal to their Actual Generation/Drawal for all the time blocks affected by the Grid Disturbance. Certification of Grid Disturbance and its duration shall be done by RLDC."
- e. Schedule Revision Due To System Requirement: "RLDC observes that there is need for revision of the schedules in the interest of better system operation; it may do so on its own. The revised schedules shall become effective from the 4th time block, counting the time block in which the revised schedule is issued by RLDC to be the first one."
- f. Revision of Schedules: "Generation schedules and drawal schedules issued/revised by RLDC shall become effective from designated time block irrespective of communication success."

#### D. Operation In ABT Regime

- ◆ Station to declare day-ahead DC on ex-bus basis to RLDC by 0900 hrs- Station O&E
  - a. Based on best estimate of availability of units.
  - b. Realistic APC assessment
  - c. Availability and quality of fuel
  - d. Loading limitations & Operational constraints condenser vacuum, ID Fan margins etc.

- e. Peak hour demand
- f. This is coordinated through RCC.

- ◆ **Prompt revision of capability in real-time- SCE**
  - a. Delay of 15 mins in reporting tripping of 500 MW unit could mean a UI of THE ORDER OF Rs. 10 LAKH
  - b. Revision based on unit performance and fuel characteristics.
  - c. Spreading out the generation over the day in case of shortage of fuel
  - d. Peak hour DC should not be less than other periods

- ◆ **Real-time management of ABT performance**
  - a. Stations have installed ABT compliant meters for monitoring and management of ABT performance
  - b. ABT compliant software

**IV. SALIENT FEATURES OF ABT**

There are three components of availability based tariff

- ◆ Capacity charges (fixed cost): Full recovery at normative availability, Apportioned to various beneficiaries as per allocation
- ◆ Energy charge: Upto scheduled energy, At normative tariff
- ◆ Unscheduled interchange (UI): Deviation from schedule, Rate linked to frequency; different UI charts over time

Here 100% generation capacities of a ISGS is allocated to beneficiaries. Fixed cost recovery is as per entitlement of individual beneficiaries (irrespective of drawal by the SEB) & calculated on annual basis. SEBs are scheduled for drawal from ISGS, based upon their requisition, limited to their entitlement. Variable charge recovery is as per norms for only scheduled energy. Norms of fixed and variable charge are declared stationwise periodically by CERC in their tariff regulation. Present Tariff Period of 2004-09.

UI charges are levied for difference in its Actual and Scheduled Generation/drawal. UI will be worked out for each 15 minutes time block. Charges for UI are frequency linked and are payable/ recoverable depending on grid frequency if:

- ◆ A generator generates more than schedule – Gets UI
- ◆ A generator generates less than the schedule – Pays UI
- ◆ A beneficiary overdraws power - Pays UI
- ◆ A beneficiary under draws power– Gets UI

Commercial mechanism contemplates equal treatment to all the participants and a self-imposed discipline. For introducing grid discipline, the concept of unscheduled interchange (UI) has been introduced. The amount of generation by ISGS or drawal by constituents, which deviates from schedule is unscheduled interchange. UI is payable or receivable depending on over or under generation. Rate of UI linked to average frequency of 15 minutes time block.

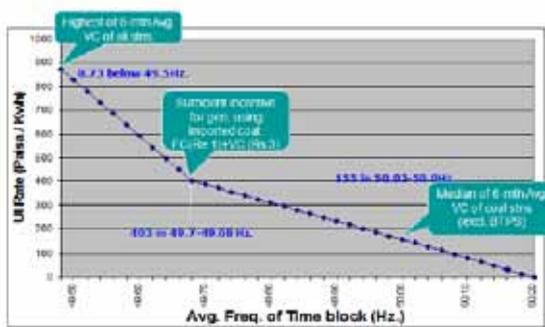


Fig. 1: A typical UI Vector

Capacity charges paid by customers are based on capacity allocation instead of earlier system of payment based on energy drawal. Capacity charges are paid to generators based

on the declared availability of the generator irrespective of the actual generation. Variable charges are being paid to the generators based on the scheduled energy instead of the actual energy drawn by the beneficiaries. Any deviation from the schedule generation/drawal are subject to unscheduled interchanges at a rate depending on the average grid frequency during each time block. [2] Fig 1 denotes a typical UI Vector. Each 0.02 Hz. step is equivalent to 15.5 p/Kwh in the 50.2-49.7 Hz. freq. range and 47 p/Kwh in the 49.68-49.5 Hz. freq. range.

**TABLE I. TYPICAL AVERAGE FREQUENCY AND UI RATES**

AVERAGE FREQUENCY OF TIME BLOCK (HZ.)		UI RATE W.E.F 01.05.2010 (PAISA / KWH)	AVERAGE FREQUENCY OF TIME BLOCK (HZ.)		UI RATE W.E.F 01.05.2010 (PAISA / KWH)	AVERAGE FREQUENCY OF TIME BLOCK (HZ.)		UI RATE W.E.F 01.05.2010 (PAISA / KWH)
BELOW	NOT BELOW		BELOW	NOT BELOW		BELOW	NOT BELOW	
	50.20	0.00	49.94	49.92	217.00	49.66	49.64	497.00
50.20	50.18	15.50	49.92	49.90	232.50	49.64	49.62	544.00
50.18	50.16	31.00	49.90	49.88	248.00	49.62	49.60	591.00
50.16	50.14	46.50	49.88	49.86	263.50	49.60	49.58	638.00
50.14	50.12	62.00	49.86	49.84	279.00	49.58	49.56	685.00
50.12	50.10	77.50	49.84	49.82	294.50	49.56	49.54	732.00
50.10	50.08	93.00	49.82	49.80	310.00	49.54	49.52	779.00
50.08	50.06	108.50	49.80	49.78	325.50	49.52	49.50	826.00
50.06	50.04	124.00	49.78	49.76	341.00	49.50		873.00
50.04	50.02	139.50	49.76	49.74	356.50			
50.02	50.00	155.00	49.74	49.72	372.00			
50.00	49.98	170.50	49.72	49.70	387.50			
49.98	49.96	186.00	49.70	49.68	403.00			
49.96	49.94	201.50	49.68	49.66	450.00			

Each 0.02 Hz. step is equivalent to 15.5 p/Kwh in the 50.2-49.7 Hz. freq. range and 47 p/Kwh in 49.7-49.5 Hz. freq. range (Applicable w.e.f 01.05.2010)

UI is being treated as a grid disciplining mechanism. For stations using Coal/ Lignite/ APM gas; UI payable and receivable to be capped at rate corresponding to 49.70- 49.68 Hz. For over-injection by a generating station beyond 105% (101% in a day)- UI receivable to be capped at rate corresponding to 50.02- 50.0 Hz.

CERC may on suo-motu or on a petition by RLDC proceed against generating station for Gaming defined as intentional mis-declaration for undue commercial gains, on investigation if found gaming, UI payable shall be made zero. Volume limits on UI below 49.7 Hz is as follows: Over-drawal by buyers/ beneficiaries: 12% of SD in a block (Max 150 MW) & (3% over a day for all blocks when f < 49.7 Hz). Under-injection by buyers/ beneficiaries: 12% of SG in a block & (3% over a day for all blocks when f < 49.7 Hz).

Additional UI Charges are Payable in addition to applicable UI charges for over-drawal/ under injection of electricity when f < 49.5 Hz,

- A. Below 49.5 Hz and up to 49.2 Hz**
  - ◆ Over drawal - 40% of UI rate at 49.5 Hz. = 349.2 p/kWh.
  - ◆ Under injection - 20% of UI rate at 49.5 Hz. = 174.6 p/kWh.
  - ◆ For Generating station using coal/lignite/APM gas as the fuel - 20% of Cap Rate = 80.6 p/kWh
- B. Below 49.2 Hz**
  - ◆ Over drawal - 100% of UI rate at 49.5 Hz. = 873 p/kWh.
  - ◆ Under injection - 40% of UI rate at 49.5 Hz. = 349.2 p/kWh.
  - ◆ For Generating station using coal/lignite/APM gas as the fuel - 40% of Cap Rate = 161.2 p/kWh

## V. IMPLICATIONS FOR DIFFERENT INDUSTRY PLAYERS

Put succinctly ABT requires all the actors in the great power drama to get their technology act right. There is no room for laxity on control or efficiency fronts. The technology dependency is going to be more on the generation side.

Capital cost of the generating facility being redeemable only against declared availability and successful demonstration of the same will require the generators to really have a tight rein on their complete infrastructure. All the generators will now need to set a target of 85% availability to ensure that complete capital costs, ROE and incentives are available to them. And the provision for surprise audit to demonstrate the availability will need to them to monitor all the equipment's and ensure adequate and timely maintenance of their overall infrastructure. This will usher a modern outlook and calls for the latest and best technology in performance calculations, efficiency and IT.

Variable costs and UI charges will require the generators to closely match their output with the demand curve and the ability to take corrective actions in the shortest possible time. ABT also calls for elaborate computation of the payable tariffs and close monitoring of the cost of production. Ushering in of MOD is going to be a positive development for all generators enabling them to make huge savings on cost. All these factors will involve a good amount of technology investment but will set the right background for an efficient power structure and the right launching pad for a market oriented approach. This will naturally result in higher reliability and increased customer confidence giving the right impetus for more industrialization and enhancing our development process.

At the consumption end also there is going to be the need to forecast demands as accurately as is possible and to follow the strictest possible grid discipline. This again will prove vastly beneficial to the power industry as a whole.

## VI. CONCLUSION

All the apprehensions regarding the new system notwithstanding, ABT is still a welcome and necessary development. Next step is for the concerned authorities to ensure the necessary infrastructure to remove all the bottlenecks on the transmission side. Once this is done, the path should be clear to a completely market driven scenario much better systems and infrastructure in place. The culminating point shall be an elaborate and efficient system with much more reliance on distributed power systems as well. This will iron out any monopoly tendencies in the system delivering maximum benefits to the consumers. This will also prove beneficial to the environment since "green power" norms are much more effectively implemented in a distributed and deregulated power scenario.

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