Preventing load shedding/black out in Distribution feeders by curtailing load/brown out.

One of the objectives of Smart Grid in India is to improve reliability of power supply in urban areas and to improve access of power in rural areas. The current energy deficit and peak load deficit is around 10-12%. The current practice to manage the energy deficit is load shedding for different feeders on a rotational basis.

As part of AMI functionality for Smart Grid Pilots, it is proposed to manage this power deficit by price signals for Demand Response and by load curtailment in place of complete load shedding. 14 smart grid pilots are shortlisted by MoP for partial funding and its outcome will decide decision for roll out of Smart Grid in India.

1. The functionality envisaged as part of Smart Grid for improving reliability is 'Brown out' in place of 'Black out' at customer premises. 'Brown out' is referred to as selective load control at the premises of consumers connected to a particular feeder on a Distribution network as against complete load shedding or 'black out' on that feeder being undertaken by utility to have demand supply match in the overall Distribution system during emergency / peak load conditions that reduces electricity supply below demand. Brown out will facilitate consumers by providing curtailed minimum lifeline supply thru Smart Meters for his lighting, fans, television etc for which at present they have to make individual arrangements of back-up power like inverter's, DG sets etc during load shedding. Consumer can save capital plus operation and maintenance cost of back-up power. Towns even in the NCR region like Gurgaon, Noida and Faridabad experience rampant and errant load shedding, especially during peak summer and winter seasons which may last for any duration from few minutes to few hours. Consumers are paying very high price of upto Rs 15-18 per unit for power back-up in residential societies in these areas which can be averted if utility promises to supply curtailed load during emergency and peak conditions and maintains SLA.

Regulatory interventions-

a. To allow load curtailment remotely.
b. To allow reliability surcharge for consumers who wish to avail 'Brown out' services in place of 'Black out' services if utility honors SLA.
c. To allow incentive to Utility personnel based on availability of power in the area under his control.

PROCESS

Three segments of consumers are envisaged while considering such load curtailment scheme:

(i) First set of consumers are those who have a sanctioned load equivalent to minimum lifeline supply and are typically BPL consumers. Utility can take the decision for shedding their load as per prevailing system conditions. Such consumers are generally non-paying consumers, but need to be metered for energy accounting and misuse of energy can be checked if their meter can set maximum threshold value of their consumption and cut-off their supply in case the usage exceeds. Meter Functionalities as Model A at Annexure-I.

(ii) Second set of consumers are those who do not have household wiring that has essential and non-essential load electrically segregated. 'Brown out' signal for such consumers that reduces their maximum sanctioned power limit temporarily to 'minimum threshold' agreed mutually for which Utility can charge reliability surcharge' can be thru mobile application or in the form of different colours of light or a sound alarm. In case the power consumption at that time is more than 'minimum threshold' , the supply will trip as is the case for normal inverter trip on overload. Consumer can switch off some load to reach the 'minimum threshold' value and reset locally from the meter. They can again get message from utility and thru meter after emergency of distribution system has been catered to for normalizing their load as per requirement. . Meter Functionalities as Model B at Annexure-I.

(iii) Third set of consumers are those who already have their essential and non essential load electrically segregated to cater to the back-up supply arrangements. For such consumers meter can have two different switches, one for complete load and another for non-essential load, and the complete 'Brown Out' and normal supply restoration will be fully automated as the consumer need not to take any manual switching or resetting of switch. . Meter Functionalities as Model C at Annexure-I.

(iv) For Bulk Consumers, Demand Side Management function can be implemented by use of smart meters in conjunction with advanced wired or wireless load controllers and automatic switches etc to exercise selective remote connect/disconnect functionality through which individual loads within customers' premises can also be turned on or off by utility to curtail their load. Meter Functionalities as Model D at Annexure-I.

(v) With smart meters it shall also be possible to completely disconnect the consumers who are not opting for the 'Brown Out' scheme, and thus for them normal load shedding roster will be applicable.

(vi) For such schemes utility shall have to guarantee reliability of minimum lifeline supply of around 1 KW load, say for 99.95% hrs(complete outage for only 4-5 hrs in a year) and limit for brown out hrs to say maximum 10 hrs per week, to such consumers and a nominal reliability surcharge of 10% of total bill may be imposed for the same. Alternatively consumers who want uncut and reliable premium supply for all the times of day could be charged a reliability surcharge of around 20% of normal rates for such premium supply. Reliability in such cases should also be for around 99.5% and there could be exceptions for critical peak events, which could be one in say 3-6 months time, which will not be considered for arriving at such reliability. In case reliability falls below requisite percent monetary penalty can be imposed on utility which could be some percent of total bill of consumer. The figures are only for illustration and can be mutually decided by Utility and Regulators on further detailing.

(vii) For managing revenue collection, the remote curtailment can help by allowing only minimum lifeline supply on non-payment by a particular consumer that can be restored to normal on receipt of payment even online payments can be accepted to avoid unnecessary harassment to the consumer as is the case for mobile bill payments. In case the consumer fails to pay even in 15 days notice period, complete disconnection can be done remotely

Benefits

Savings for utility shall be in the form of additional income in the form of reliability surcharge, reduction of losses due to system not being overloaded and improved customer satisfaction etc. Customer will avoid costly back-up arrangements.

There could also be provision for incentive/disincentive to utility personnel maintaining such feeders/consumers for achievement/non-achievement of reliability parameters.

2. DYNAMIC PRICING

Another way of managing power deficit could be through pricing signals in form of ToU/RTP pricing wherein consumer can himself chose to curtail load during

peak load period of high prices upon receiving signal from utility and consume more load during off-peak periods when prices are low thereby making saving on his electricity bill. Meter can give three colored signals thru mobile application or simple hand held device/ LED display panel at home. This display/ mobile application can also give current consumption parameters to the consumer who can then budget his consumption to suit his pocket. Meter should have programmable integration period feature as currently it is proposed to use 15 minutes integration for applying frequency linked incentive/disincentive as detailed below.

The proposed dynamic tariff structure components for Smart Grid Pilots circulated to Utilities is as given below:-

a. **Frequency-based, ToU pricing**, Availability-based tariff (ABT) and UI charges are already deployed for Transmission sector. Indian version of Availability Tariff comprises of three components: (a) capacity charge, towards reimbursement of the fixed cost of the plant, linked to the plant's declared capacity to supply MWs, (b) energy charge, to reimburse the fuel cost for scheduled generation, and (c) a payment (UI charge) for deviations from schedule, at a rate dependent on frequency. ABT could bring discipline in transmission sector in abiding to agreed-upon schedules worked per the Indian Electricity Grid Code (IEGC) by the constituents of Indian Power grid. The same can be tweaked for Distribution sector and accordingly this ToU tariff is proposed to be +/- 20% of tariff calculated on the basis of ARR to be levied in case frequency falls below 49.7Hz and rises above 49.95Hz.

   ToU will aim for near real-time load-supply balancing. As suggested above, three rates can be administered:

   I. ARR rate for frequency in acceptable band (e.g., Rs 4.5 per kWh)
   II. ARR x 1.2 for frequency below lower limit of acceptable band (i.e., Rs 5.4 per kWh)
   III. ARR x 0.8 for frequency above upper limit of acceptable band (i.e. Rs 3.6 per kWh).

   Smart meters can communicate with simple LED based display units that may be provided in multiple rooms to show the above three rates as RED/YELLOW/GREEN colors to the end consumer, and this can also be published on a utility's portal. Consumers can also be notified about a change in rates through a small beep sound from the meter.

b. Pre-determined ToD pricing for the utility-specific peak load time zones, to be announced weekly by the Regulatory Commission based on forecast peak load time/ past data from Regional load dispatch centres RLDCs. This can be 10% of the tariff calculated as per existing ARR petition.

c. A reliability surcharge-Utility may consider levying a surcharge of 10% over total bill amount in the areas that have rugged distribution infrastructure so as to provide reliable power supply based on service level agreement (SLA) with consumers of that area. In case SLA is violated no surcharge will be admissible for that month. Reliability can be maintained by switching to load curtailment (with commitment to supply lifeline supply for that premises) in place of load shedding in those areas. In order to increase available power, installation of roof top solar panels can be promoted by utilities' floating suitable incentive schemes. Smart consumers can also store solar energy during the day time and use it during evening peak times to avoid purchase of costly power during peak load time.
d. Discount of 2% to 5% on pre–paid bills depending on AT&C losses for that area. The higher the losses, the lower the discount for pre-paid bills that may encourage people of that area to identify theft.

The figures are only for illustration and can be mutually decided by Utility and Regulators on further detailing.

After further discussions with utilities, the proposed dynamic price structure can be implemented for smart grid pilots in parallel to the existing billing mechanism in order to test actual impact on load profile, tariff, and revenue for the utility from that area. In order to avoid resistance to change, consumers may be given an option to opt out of the new price structure and a commitment that the bill as per new tariff structure shall not exceed the bill as per conventional tariff structure except for reliability surcharge that will be payable only if agreed mutually by a group of consumers served by same Distribution transformer. Further improvement of the price mechanism can be based on the outcome of pilots

ANNEXURE-I

PROPOSED FUNCTIONAL SPECIFICATIONS FOR SINGLE PHASE SMART METERS

Consumer	Goal	Action	Options	Meter Function	Optional
A. Low cost meter for small consumers Say with Load Limit x-kW	Proper accounting of energy			Pre-paid /AMR meter with load limit switch **UART for Communication**	
B.Residential / Agriculture consumers in Rural areas	Access of power to be improved	Power supply hrs to be increased	Subsidised roof top panels with smart inverters	Pre-Paid/ Smart meter with load limit switch that can be programmed remotely, gives overload alert to users, no supply alert to Utility in real time. **UART for Communication**	With additional measuring unit for Export
C.Residential consumers in Urban Areas with 'x' kW and less than 'Y'Kw consumption	Reliable power supply and quality power supply	Load curtailment in place of load shedding Separate circuit for light load and power load	Subsidized roof top panels with smart inverters,	1. Smart meters with additional relay for load curtailment 2. Real time Alert for Under Voltage no supply alert to Utility in real time. **UART for Communication**	With additional measuring unit for export
D.Residential consumers in Urban Areas with bulk consumption say above 'y' Kw sanctioned load	Reliable power supply and quality of power supply	Efficient use of energy	In home display Micro Grid	Smart Meters With all functionalities for DSM wherein Utility can directly control load thru HAN with higher meter rents from the consumer and proper incentive for consumers for stepped load relief. 3. Data transfer after every 30 minutes **With additional Cellular Communication for DSM**.	With additional measuring unit for export

- **If Pilots are successful Utility to establish Scalable Data Centre that can read and control proposed smart meters prior to purchasing of Smart Meters. (**100% metering to be achieved as per National Electricity Policy)
- **ToU Tariffs that are based on real time load supply balance and facilitated thru smart meters can help Utility to manage renewable integration as well as better serve the consumers. Integration period to be programmable in the meters.** Presently only 65% access of Power is there, that can be addressed if Distributed generation is promoted by suitable incentives and regulations.
- **Smart Meters can also facilitate virtual Feeder segregation, that can save huge infrastructure costs and offset some of the cost for Smart functions like remote connect/disconnect in the meter.**