Introduction of Derivative Power Market in India

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***Abstract*— As a country India has to prepare its systems for meeting the renewable energy (RE) target of 175 GW by 2022 set by the Government of India. Additionally, the new Tariff Policy mandates SERCs to reserve a minimum percentage for purchase of solar energy from the date of notification of the policy which shall be such that it reaches 8% of total consumption of energy, excluding Hydro Power, by March 2022. This level of penetration of renewable into the grid is unprecedented, and will throw up a variety of challenges in integration as well as grid management. This will also change the way Indian Power Market operates. Currently, Indian Power market has three main platforms namely a) Spot Market b) Term Ahead Market c) Renewable Energy Certificate (REC) Mechanism. For Renewable, there is only REC market. REC market was introduced in the backdrop of poor transmission infrastructure and poor power communication infrastructure in India. However, now scenario in Indian power sector has changed after very high transmission expansion and investment in power communication infrastructure. Secondly, Solar and Wind Energy generators are waived off Inter-State transmission charges. Therefore, in this backdrop, India has to prepare itself for balancing market for Renewable Energy which is operational in developed countries. The paper highlights future Market design, regulatory issues related to Variable Renewable Energy and provides mechanism to introduce derivative market in Indian Power Market.**

Keywords-Renewable Energy Integration;Power Market; Derivative Power Market; Futures.

INTRODUCTION

In late 2000s, Indian governments began offering fiscal and financial incentives to firms building renewable energy projects. By this added incentives and benefits associated with climate change, renewable energy has become the power of choice for investors. The country has witnessed a kind of revolution in solar power addition as a low of 2 MW installed capacity in 2010 has been increased to 13115 MW as on 30th June, 2017.The Wind energy has also very significant presence in Indian energy mix. As a country, India has to prepare its systems for meeting the renewable energy (RE) target of 175 GW by 2022 set by the Government of India. Additionally, the new Tariff Policy mandates SERCs to reserve a minimum percentage for purchase of solar energy from the date of notification of the policy which shall be such that it reaches 8% of total consumption of energy, excluding Hydro Power, by March 2022. This level of penetration of renewable into the grid is unprecedented, and will throw up a variety of challenges in integration as well as grid management.

Challenges because of Renewable Energy

Given the variable and uncertain nature of wind and solar, there are a number of challenges in mainstreaming such sources of generation, viz. -

a. Forecasting – forecasting of wind and solar is a challenge and demands pro-active intervention of stakeholders

b. Scheduling – Given the uncertainty of forecasting, scheduling also become difficult

c. Deviation Settlement – Inadequacy of forecasting and scheduling could result in adverse commercial impact in terms of deviation charge

d. Reserves/flexible generation – There is a need for balancing power to handle the variation of wind and solar

While these remain challenges, they are not insurmountable. A proper policy and regulatory framework coupled with cooperation of the stakeholders can help overcome the challenges.

GRID INTEGRATION ISSUES WITH RENEWABLE ENERGY AND ADDRESS THE CHALLENGES

In 2013, CEA published a document titled “Large Scale Grid Integration: The Way Ahead”. This document provides basic technical requirement for large scale grid integration. The document started with challenges of variability and intermittency of Renewable Energy Generation. As per the document, the mitigation of challenges of Renewable Energy generation may be overcome by better forecasting technologies, expansion of transmission grid, use of Static VAR Compensator/STATCOM, expanding balancing area, and establishment of Renewable Energy Management Centre (REMC).

A central challenge of the power sector is how to integrate higher shares of renewable energy. This is often referred to as the “grid integration challenge.”[1] Although there is no commonly cited definition of “grid integration,” the California Public Utilities Commission (CPUC) offers this definition: “the process to achieve grid integration is to solve a set of three interlinked challenges, and to harness the opportunities created by these challenges: (a) to integrate wind and solar resources, in increasing amounts, onto the grid, particularly at the bulk or transmission level (b) to respond to the changes in system-wide customer load due to increased rooftop solar installations and connected electric vehicles (c) to bring about, in concert: changes to the characteristics of traditional resources, changes to the functionality and role of distributed energy resources, changes to operational and planning practices at both transmission and distribution levels, and changes to wholesale and retail markets and tariffs".

As per the above definition of grid integration and three interlinked challenges, "Large Scale Grid Integration: The Way Ahead": the document of CEA provided solution only for the first challenge according to this definition. There were mainly five proposals one is on forecasting, second one is installation of SVCs/STATCOM, third one is on transmission expansion, fourth one is enlargement of balancing area and fifth one is establishment of REMC.

First Proposal i.e on Forecasting: Interstate Forecasting and Scheduling regulation has already been notified in 2015 by Central Electricity Regulatory Commission (CERC). Power System Operator Company has recently launched a "Mobile App" with the collaboration with Indian Meteorological Department (IMD) for weather forecasting.

Second Proposal i.e on installation of SVCs/STATCOM: Installation of STATCOM is planned in solar parks in India. Installation of SVCs/STATCOM is part of transmission planning.

Third Proposal i.e on transmission expansion: In pursuance to dispatch Renewable Energy from renewable rich areas a cluster based approach was thought of, renewable rich clusters were identified and transmission corridors were planned accordingly. The name given to this transmission corridor is Green Energy Corridor. Green Energy Corridor Phase I is already sanctioned by Indian Government and in different phases of implementation. Fourth Proposal i.e on expansion of balancing area: India is divided into five different regions of Transmission grid. The regions are a) North b) East c) North East d) West and e) South. In 2014, South region was synchronized with rest of regions. This synchronization results in a single grid for the entire nation. As per the role provided to Regional Load Dispatch Centre (RLDC) by Electricity Act, 2003, the balancing of the grid in its region is the responsibility of RLDC. With the synchronization of southern grid which is also region of renewable rich states, the balancing area got increased to entire nation.

On fifth proposal on REMC: Detailed Project Report (DPR) has been approved and cabinet has given nod for the establishment of REMC. As per the latest information, Power Grid Corporation of India Limited (PGCIL) is given mandate to establishment of REMC. By March 2018, the first REMC in Bangalore will be set up.

On the above it may be observed that the first challenge of Grid Integration as per CPUC definition has been almost being addressed by Indian Government. However, on second definition of grid integration i.e. to respond to the changes in system-wide customer load due to increased rooftop solar installations and connected electric vehicles, the work is still under consideration of different agencies of government of India. The work may be like interconnecting a distribution generation (DG) to the distribution feeder and its impact on customer load. Interconnecting a DG to the distribution feeder can have significant effects on the system such as power flow, voltage regulation, reliability etc. A DG installation changes traditional characteristics of the distribution system. Most of the distribution systems are designed such that the power flows in one direction. The installation of a DG introduces another source in the system. When the DG power is more than the downstream load, it sends power upstream reversing the direction of power flow and at some point between the DG and substation; the real power flow is zero due to back flow of power from DG. For this two way flow of power, we need special equipment like net metering. IEEE 1547 is specially designed with collaboration from many researchers around the world for the study of interconnection of DG with distribution feeder.

Now on the third challenge as per definition of CPUC i.e to bring about, in concert: changes to the characteristics of traditional resources, changes to the functionality and role of distributed energy resources, changes to operational and planning practices at both transmission and distribution levels, and changes to wholesale and retail markets and tariffs, a report on balancing of grid by Ministry of Power [2016], reported on the importance of the grid stability which is a key consideration for interconnection of any new system to the existing grid stresses upon the variable nature of wind power necessitate the development of interconnection standards to enable the grid to sustain the variability without affecting the power quality adversely.

On analyzing third challenge of grid integration as defined by CPUC, it may be concluded that the development of a market based electricity system, risk management and infusing competition in electricity market are primary objectives to address the challenge. There are markets like Ancillary Services Market, Capacity Market, Balancing Market, Financial Transmission Rights Markets and Derivative Market need to be developed to address third challenge. With this paper, possibility of introduction of derivatives in Indian Power Markets is explored.

POWER MARKET IN INDIA

After 1991 of Liberalization, Privatization and Globalization, electricity demand in the country has increased rapidly and is expected to rise further in the years to come. In order to meet the increasing demand for electricity in the country, the electricity supply chain consisting of generation, transmission and distribution has undergone a phase of transformation to competitiveness. In 1998, Central Electricity Regulatory Commission was established and was mandated for tariff determination. This was the first time, Government of India transferred the role of tariff determination to a quasi-judicial and independent regulator. Later in 2003, Electricity Act was enacted. This act was instrumental in infusing competition in Indian power sector. A year later in 2004, non-discriminatory open access in electricity sector was introduced which provided further impetus for enhancing competition in the market. The responsibility of developing the market in electricity has been vested with the Regulatory Commission. In pursuance of the provisions of Electricity Act, 2003, Central Commission formulated regulations like the open access regulations, inter-state trading regulations, trading margin regulations, power market regulations etc. to facilitated power trading in India. One more welcome step the Indian electricity market has seen is the implementation of Availability Based Tariff (ABT) which brought about the effective day-ahead scheduling and frequency sensitive charges for the deviation from the schedule for efficient real-time balancing.

In the ABT, the fixed and variable costs of electricity production are treated separately. Fixed cost, known as capacity charge, is associated with the availability of the plant and its capacity to deliver MWs on day-to-day basis. Generating plant is paid the capacity charge according to its average availability over a year. Variable charge, known as energy charge, is the charge associated with the variable cost of energy production and the total amount paid to the generators is based on their scheduled energy production rather than actual production. The third component of ABT is called unscheduled interchange which is the payment for deviation from the schedule, and the rate is decided according to the system frequency and according to deviation settlement mechanism regulation. Beneficiaries are paid for the underdrawal or charged for the overdrawal according to the system frequency. Thus the UI mechanism acts as a balancing market in which real-time price of the electricity is determined by the system frequency.

Before Electricity Act, 2003 and in the absence of short term power market and risk hedging options, in India, majority of power supply contracts are in long terms. Almost ninety percent of power trading is in long term. The distribution utilities which have the obligation to provide electricity to their consumers mainly rely on supplies from these long-term contracts. However, after enactment of Electricity Act, 2003, to meet the short-term requirements of the market participants, short term trading plays an important role in the power market. Inter-state trading licensees (traders) have been undertaking trading in electricity since 2004 and the power exchanges started operating since 2008. The two power exchanges, IEX and PXIL started their operations in June 2008 and October 2008 respectively. Currently, two electricity trading exchanges (IEX and PXIL) are running in India.

Indian Power exchanges have three main platforms namely a) Spot Market b) Term Ahead Market c) Renewable Energy Certificate (REC) Mechanism. For Renewable, there is only REC market. REC market was introduced in the backdrop of poor transmission infrastructure and poor power communication infrastructure in India. REC market is not doing well because of high supply and low demand. However, now scenario in Indian power sector has also changed after very high transmission expansion and investment in power communication infrastructure like the envisaged set up of Renewable Energy management Centre. There should be mechanism so that Renewable Energy generator may participate in Indian Power market. The minimum, maximum and weighted average prices have been computed for the electricity transacted through IEX and PXIL separately. The minimum, maximum and weighted average prices were Rs0.70/kWh, Rs 4.70/kWh and Rs2.83/kWh respectively in IEX and Rs2.12/kWh, Rs3.84/kWh and Rs 2.79/kWh respectively in PXIL. The price of electricity transacted through IEX and PXIL in the term-ahead market was Rs 3.27/kWh and Rs 3.56/kWh respectively.[8]

It is clearly observed from the above details, in India, there is huge variation of prices in Power market. The variation may be more prominent in short term power market when Renewable Energy will have a significant share in total electricity mix. Due to the variations, there will be more risk which can be handled by derivative instruments.

IV. Derivative Introduction

A derivative is a financial instrument (contract) between two parties with opposite views on the market, who are willing to exchange certain risks [2]. Derivative is defined as an instrument which derives its value from underlying assets. In the case of electricity derivative, underlying asset is price of electricity.

V. Products of Derivative Market

There are three popular derivative instruments Futures, Forward, and Options.

Future Contracts

Future contracts include an obligation to buy or sell a specified quantity of an asset at a certain future time for a certain price. The futures are standardized contracts which are traded on and cleared by an exchange and the exchange could guarantee that the contract would be honored [3]. It is to be noted that the only point of negotiation is the price. All other terms and conditions are pre-specified, thereby making it a standardized contract. The main justification of futures contract is that it permits specialization between two elements of the economic process: the function of holding commodities and the function of bearing the risk of price changes [4]. The seller of a futures contract on a commodity does not normally intend to deliver the actual commodity nor does the buyer intend to accept delivery; each will, at some time prior to delivery specified in the contract, cancel out obligation by an offsetting purchase or sell. In fact, historically, less than one or two percent of futures contract have been fulfilled by actual delivery.

Forward Contracts

Forward contract are almost similar to future contracts. They include an obligation to buy or sell a specified quantity of an asset at a certain future time for a certain price. Forward contracts are traded bilaterally or over the counter between two financial institutions or between a financial institution and one of its corporate clients and the contracted parties usually customize the contract in order to make it fit their needs [4]. Usually, in future contracts, there is a range of possible delivery date. Whereas forward contracts have a specific expiration at which the asset is delivered and payment is made. The buyer of contract is called long. The seller of the contract is called short.

Contract for Differences (CfDs)

CfDs, which are mechanisms to stabilize the power costs to consumers and revenues to generators, is one form of forward contract. These contracts are suggested due to the fact that the spot price set by pooling company fluctuates over a wide range and difficult to forecast over a long period. When spot price is above the strike price, the seller pays buyer an amount equal to difference between the spot price and strike price and when the spot price is below the strike price, buyer pays the seller an amount equal to the difference between strike price and spot price. Thus both parties have hedged their exposure to spot price.

Option Contracts

An option contract includes a right (not obligation) to buy or sell a specified quantity of an asset at a certain future time for a certain price. In case of futures/forwards, contract is either held for delivery or liquidity, but option contracts may be held for liquidity, delivery or expire worthlessly To enter an option contract, the buyer pays a premium to the seller of options, while in futures and forwards, the buyer does not have to pay any charges. A call option gives the holder the right to purchase the underlying asset at some future date, and a put option gives the holder the right to sell the underlying asset at some future date. There are many exotic options available to hedge risks.

VI. Regulatory Interventions required to get Derivatives implemented in India

In India, Electricity is a scheduled commodity as such provisions of Forward Contracts Regulation Act, 1952. Options in Commodities are not permitted by this act. Therefore, first of all, it needs to get it clarified that whether Electricity Market will be regulated by Forward Contracts Regulation Act, 1952 or not. Derivative market used for hedging should be allowed keeping in mind the interests of end consumer. Financial conditions of majority of Distribution Utilities are not very good in India. However, UDAY scheme has been launched to turn around financial conditions of distribution utilities. It should be ensured that only high credit worthy distribution utilities will participate in derivative markets. Regulators while must be aware of the risks faced by distribution utilities, marketers and others, and allow them to take steps to manage these risks responsibly. The use of futures and other derivatives raises at least three key regulatory concerns: system reliability, financial risk, and market power. [6]

System Reliability

Restructuring and the introduction of competition have increased financial risk for generators and distribution companies. The introduction of electric derivatives may either magnify or mitigate these financial risks. Yet, while it is possible that financial losses associated with futures or other derivatives contracts could produce losses catastrophic enough to result in the bankruptcy of a generator or distribution company, it is unlikely that physical reliability of the grid would be threatened even in such an extreme case.

Financial Risk

In the context of futures, financial risk comes from three sources: speculation, margin calls, and unhedged price risk. Because futures are highly leveraged investments, speculation can lead to almost unlimited financial risk. Unlike speculation, a properly executed hedge can only reduce risk. But the term “properly executed” includes the requirement that hedgers be able to meet all margin calls between the date of purchase and the settlement date. If hedgers have insufficient funds at their disposal, unexpected price movements can result in failure to post margin and the hedger will be “sold out.” If this happens, the hedging strategy is broken and the intended hedge becomes defacto speculation. Finally, unhedged price risk is not the result of hedging but results if the hedge is inadequate. The hedge can be inadequate for three reasons: (1) a utility has imprudently made inadequate use of futures, (2) a utility has prudently restricted its hedging because of cash flow or other considerations, or (3) because no fully adequate future is available.

Market Power

Distribution utilities may have an additional incentive to hedge if they have sufficient market power to influence power exchange prices and, in so doing, can earn returns on positions taken in the futures or other derivatives markets.

VII. Conclusion

In future reforms of Indian Power Market, electricity derivatives play an important role in establishing price signals, providing price discovery, facilitating effective risk management, inducing capacity investments in generation and transmission, and enabling capital formation. Custom design of electricity financial instruments and structured transactions can provide energy price certainty, hedge volumetric risk, synthesize generation and transmission capacity, and implement interruptible service contracts. Admittedly, many exotic forms of electricity derivatives can meet specific needs for hedging and speculation. However, to implement derivative instruments, the structural changes need to be addressed. The majority of challenges in Indian Power sector is structural and needs higher investment in terms of better communication infrastructure, augmenting of transmission and smart control equipment at every level of power infrastructure viz. generation, transmission and distribution. Distribution Utilities are in red, in such a scenario, Indian government has to come with innovative policy measures in improving power infrastructure to improve scenarios in Indian Power Market. The challenges are more now in view of large grid based renewable energy generators. In view of large renewable energy target of 175 GW additions till 2022, renewable generators will have to evolve from asset developers and investment managers into power market players. To make that shift and to drive profitability, generators will need to invest in production forecast, portfolio optimization, risk management and scheduling. Without these, development of derivative market is mere a mirage in Indian Power Market.

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