IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 7, July 2015.
www.ijiset.com
ISSN 2348 – 7968

Distribution generation scenario in Indian context: An Review

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ABSTRACT: Distributed Generation playing a important role in the electricity paradigm of the world. In India also DG in form of renewable energy resources contributing to the Indian power sector. In this paper we have discussed the scenario for distributed generation with progress and achievement so far in India. We have focused on the renewable energy resources because of its advantage and pollution free electricity towards making Indian power sector neat and clean (green country).With the use of Distributed Generation either grid connected or in off mode there are some issues that should be resolved for making Distributed Generation system more efficient and reliable.

Keywords:Distributed Generation (DG), ministry of renewable energy resources (MNES), Distributed Energy Resources (DER).

I. Introduction

Asthe INDIA addresses the challenges of achieving energy sustainability in the 21st century, the recognition of the need to find alternatives to current practices has been stymied by the identification of many complexities: including matching supply and demand, the scale of current and projected needs, and the difficulty of replacing the present unidirectional system with far more complex hybrid systems utilizing disparate sources and supplies of energy. One of the major challenges is designing new systems that leverage existing infrastructure based on centralized generation to take advantage of alternative sources at a local level. The examination of past energy technology practices at historic sites can provide us with some lessons for new system designs that integrate centralized generation with local resources, and match distributed demand with local supply. The objective of energy sustainability can be approached today in the way it was in the past: as a site specific problem of achieving minimal or zero net demand. By applying modern technology and ecological knowledge, we can utilize local resources in a way that causes little or no environmental damage. In recent time, local onsite power production was gradually abandoned in favour of ever larger and more centralized energy production. These massive centralized systems have become more and more difficult and expensive to manage effectively and sustainably. After first exploiting many hydropower resources through dams and impoundments in the early part of the century, and depleting most domestic supplies of petroleum INDIA became increasingly dependent on foreign supplies of fossil fuels to power our industries. As long as these resources were cheap and plentiful, it made sense to shift our means of production away from local resources. But now we are faced with the dilemma of declining production and Supplies which are slated to become ever more scarce and expensive. It is time for us to reacquaint ourselves with Local energy production, and educate ourselves about reducing our demand for offsite energy by meeting as much Of the need as possible using onsite energy sources. The great benefit of rediscovering these local energy resources is the potential to create facilities that meet all or a large part of their own energy needs without requiring long distance energy transmission. Local energy production reduces waste by lessening dependence on the infrastructure of large power plants and distribution systems which are notoriously inefficient.Installation of a large number of small sources called distributed generation creates many problems in proper control of national (and India) power grid. At the same time new technologies especially power electronics and measurement datacomputing associated with smart grid allows using better and conscious these distributed sources; smart grid approach may take advantage of specific characteristic of distributed sources for ensuring more reliable quality of supply. With the help of local generation or distributed generation we will be able to make a decentralized system, more reliable, secure and pollution free energy system

II. DISTRIBUTED GENERATION AND SUSTAINABILITY

According to the Ministry of New and Renewable Energy, Govt. of India at the time of independence in the year 1947 only 1362 MW of electricity was produced in India. India paid considerable attention to the generation of power as a result of which the installed capacity of power generation till 2010 has grown to 164,509 MW of which Hydro is 37086 MW (25%), Thermal is 106,433MW (65%), Nuclear is 4560MW (2.9%) and Renewable energy sources 16429MW (7.7%) The share of small scale hydropower (SHP) is 2,820 MW[1][2]. The total Installed capacity of power utilities in the country increased from 14,709 MW in 1970-71 to 173,626 MW as on 31.3.11, with a CAGR of 6.2 % over the period. The highest CAGR (7.1%) was in case of Thermal utilities followed by Nuclear (6.1%) and Hydro (4.4%)[11].The electricity sector in India had an installed capacity of 211.766 GW as of January 2013, the world's fifth largest. Captive power plants generate an additional 31.5 GW. Non Renewable Power Plants constitute 88.55% of the installed capacity and 11.45% of Renewable Capacity. The International Energy Agency estimates India will add between 600 GW to 1200 GW of additional new power generation capacity before 2050[12]. The technologies and fuel sources India adopts, as it adds this electricity generation capacity, may make significant impact to global resource usage and environmental issues. Since INDIA is making good progress from the generation point of view, but the percentage of renewable sources is not contributing with same rate. As of December 2011, India had an installed capacity of about 22.4 GW of renewal technologies-based electricity, about 12% of its total. India had add 3.6 GW of renewal energy installed capacity by December 2012 By making use of DG we have to focus on the green electricity at a greater extent because India plans to add about 30 GW of installed electricity generation capacity based on renewal energy technologies, by 2017. Like in other developing countries, there is also a wide gap between demand and supply in India [18]. So there is also considerable environmental and resource degradation because of a higher dependence on fossil fuels.

The non-renewable options considered are internal combustion engines fuelled by diesel, natural gas and micro turbines and fuel cells fired by natural gas. The renewable technologies considered are wind, solar photovoltaic, biomass gasification and biogases cogeneration. PEM Fuel cells and micro turbines based on natural gas need a few demonstrations projects and cost reductions before becoming viable[1]. Among the non-renewable DG options considered, diesel engines are prevalent in India. This is because of the scarcity of capital and low load factors (use as backup power). In view of the government liquid fuel policy gas engines are likely to be the preferred option for DG. Gas engines are cost competitive in view of the relatively low natural gas price. These are likely to be the preferred option for DG in areas where natural gas is available. The existing engine manufacturers need to promote their gas engines in India. India has planned for DG meeting 10% of India's power in future by 2015. For meeting this demand we need to take a glance on the renewable energy resource distributed generation.

(A) SOLAR POWER

India is densely populated and has high solar insulations, an ideal combination for using solar power in India. In the solar energy sector, some large projects have been proposed, and a 35,000 km^2 area of the Thar Desert has been set aside for solar power projects, sufficient to generate 700 GW to 2,100 GW. Also India's Ministry of New and Renewable Energy has released the JNNSM Phase 2 Draft Policy, by which the Government aims to install 10GW of Solar Power and of this 10 GW target, 4 GW would fall under the central scheme and the remaining 6 GW under various State specific schemes[8]. In July 2009, India unveiled a US$19 billion plan to produce 20 GW of solar power by 2020. Under the plan, the use of solar-powered equipment and applications would be made compulsory in all government buildings, as well as hospitals and hotels. On 18 November 2009, it was reported that India was ready to launch its National Solar Mission under the National Action Plan on Climate Change, with plans to generate 1,000 MW of power by 2013. From August 2011 to July 2012, India went from 2.5 MW of grid connected photo voltaic to over 1,000 MW[15]. The amount of solar energy produced in India in 2007 was less than 1% of the total energy demand. The grid-interactive solar power as of December 2010 was merely 10 MW. Government-funded solar energy in India only accounted for approximately 6.4 MW-yr of power as of 2005. However, India is ranked number one in terms of solar energy production per watt installed, with an insulation of 1,700 to 1,900 kilowatt hours per kilowatt peak (kWh/KWp). 25.1 MW was added in 2010 and 468.3 MW in 2011. By July 2012 the installed grid connected photo voltaic had increased to 1040.67 MW,[and India expects to install an additional 10,000 MW by 2017, and a total of 20,000 MW by 2022[14].DG supply the power either grid connected or off grid. In India there is more focus in the area of rural electrification because there is good sun season in India so it is better option for local energy resource either grid connected or off grid. The government has also established Jawaharlal Nehru National Solar Mission towards the encouraging solar power in India.

(B) WIND POWER

India is already a leader in wind power generation. As of 31 Dec 2012 the installed capacity of wind power in India was 18420 MW. Wind power accounts for 6% of India's total installed power capacity, and it generates 1.6% of the country's power. Most of the installed wind capacity is grid-connected [1]. The wind resources of India have been mapped (data from 1000 monitoring stations throughout the country). The average cost of generation (at the average load factor of 13.3%) is Rs. 5.14/kWh. This implies that several unviable wind turbines have been installed. This was due to the intial incentives based on capital subsidies and tax benefits due to 100% depreciation. Incentives were not linked to generation. Profit making companies set up wind farms to avail of the tax benefits. In many cases due to improper siting, the actual generation and capacity factors were low. There have been policy correlations. This resulted in a slow-down of capacity additions during 1996–1998 followed by a more sustainable wind capacity addition. The initial experience had many unviable wind machines being installed in a hurry to avail tax benefits without considering wind sitting issues. Many of the machines were designed for European wind regimes that are different from the Indian wind regime (more seasonal and monsoon driven). The MNES has tried to improve the capacity utilization through technology development and emphasis on micro-sitting. The MNES has established a dedicated research center for wind energy technology (CWET).India has a large wind resource assessment effort with more than 1000 wind monitoring stations. The wind energy pro operates commercially and is facilitated by the availability of innovative financing schemes from the Indian Renewable Energy Development Agency (IREDA). In order to promote wind, the government has provided several incentives like 100% accelerated depreciation. Many state governments have provided capital subsidies (Andhra Pradesh, Maharashtra, Karnataka upto 20%), sales tax exemption. Most utilities permit wheeling, banking and buy-back (purchase price of Rs. 2.25/kWh in 1994–1995 with an escalation of 5% per year).

(C) HYDRO POWER

India was the 7th largest producer of hydroelectric power in 2008 after Norway. The potential for hydroelectric power in India is one of the greatest in the world. India is endowed with economically exploitable and viable hydro potential assessed to be about 84,000 MW at 60% load factor [28]. In addition, 6780 MW in terms of installed capacity from Small, Mini, and Micro Hydro schemes have been assessed. Also, 56 sites for pumped storage schemes with an aggregate installed capacity of 94,000 MW have been identified. It is the most widely used form of renewable energy. India is blessed with immense amount of hydro-electric potential and ranks 5th in terms of exploitable hydro-potential on global scenario. The present installed capacity is approximately **37,367.4 MW** which is **21.53%** of total Electricity Generation in India. The public sector has a predominant share of 97% in this sector. National Hydroelectric Power Corporation (NHPC), Northeast Electric Power Company (NEEPCO), Satluj jal vidyut nigam (SJVNL), Tehri Hydro Development Corporation, NTPC-Hydro are a few public sector companies engaged in development of Hydroelectric Power in India.

(D) BIO-FUELS AND WASTE-TO-ENERGY PRODUCTION

Major programs in India for power generation from renewable include wind, biomass (cogeneration and gasifiers), small hydro, solar, and energy from wastes.

The final step in our tour of distributed energy generation is closing the loop to examine our most underutilized energy resource in the INDIA. Policies and Programmes for Biomass based Electric Power have been started.

The organized thrust on biomass based electric power in India has a recent origin. The programme took shape after the MNES appointed the task force in 1993 and recommended thrust on boi-gase based cogeneration [27]. The National Programme on Boi-gase based Co-generation, launched in 1994, provided for:

i) the subsidies for specific demonstration projects, ii) support for R&D activities, and iii) support for training, awareness activities, and publicity[9][10]. One ground for justifying the capital subsidy and financial support is that the capital cost of cogeneration plant is too high, almost equivalent to the cost of a new sugar mill. Besides, there is little institutional support for getting economic tariffs for the surplus cogenerated electricity. The programme was modified in August 1995 and subsequently in September 1996 to attract sugar mills in the co-operative and public sector. The important features of the programme are:

1) Demonstration scheme provides a subsidy up to Rs. 60 million per project for 12 projects. The co-operative and public sector units are offered additional benefits of 20 million per Mega Watt (MW) of surplus power comprising of subsidies and soft loans.

2) Interest subsidy Scheme which provides grants up to Rs. 3.5 million per MW of surplus power to financial institutions for them to reduce the interest rates on loans.

3) Support to R&D Projects which contribute to enhancement of power potential.

4) Indirect Programmes, like awareness activities such as seminars and business meets in sugar producing centres funded and run by MNES, technical support like making available services of international experts and organizing interaction meetings among the stakeholders like state governments, utilities, financial institutions, manufacturers, consultants and project parties.

5) International support such as i) $ 12.5 million USAID/GEF project for promotion of alternative biomass use in co-generation using off-season and ii) an ADB line of credit of $ 100 million.

Programme for biomass combustion based power has even more recent origin. It began in late 1994 with as a Pilot Programme launched with approval of two 5 MW projects. Interest subsidy programmes on the lines of that for the boi-gase based co-generation was extended in 1995. The programme also initiated a grid connected biomass gasification R&D-cum Demonstration project of 500 Kilo Watt (KW) capacity. A decentralized electricity generation programme initiated in 1995 provided support for total of 10 to 15 MW of small decentralized projects aimed at energy self sufficiency in locals with electricity deficient rural locals. It is targeted to set up 500 MW biomass power capacity during the plan period. Significant

ISSN 2348 – 7968

allocations are proposed for R&D activities (Rs. 770 million) and technical assistance and publicity support (Rs. 90 million). It is also proposed to estimate the biomass potential in different locations in India to guide the technology promotion effort.

Megawatt Scale Grid Connected Power Generation: The recent thrust of the biomass power programme is on the grid connected megawatt scale power generation using variety of biomass materials such as rice straw, rice husk, biogases, wood waste, wood, wild bushes and paper mill waste. Power generation potential from biomass gasification is estimated at 17000 MW (MNES, 1993a) and another 3500 MW (MNES, 1993b) using sugarcane residues. Reputed Indian engineering firm, Bharat Heavy Electricals Limited (BHEL) has carried out extensive trials to determine the combustion characteristics of variety of biomass materials. Several other boiler manufacturers in India have acquired the experience in designing boilers for biomass applications. Nearly 55 MW of grid connected biomass power capacity is commissioned and another 90 MW capacity is under construction. Enhanced scale has improved both the economics and technology of biomass power generation. The technology has improved lately to global standards with the Indian companies entering into joint ventures with leading international manufacturers of turbines and electronic governors.

III. DISTRIBUTED GENERATION CHALLENGES

Type and strength of interaction of small sources from distributed generation depends largely on types of these sources. The distributed generation consists of small sources that at present have no connection with power grid. Thus, their actually generated power is unknown to grid. Furthermore many of these sources are weather dependent (e.g. wind or solar) and in any moment can stop their energy supply. Besides that, small generators more frequently break down because in small sources is not worth to install developed and expensive monitoring system and keep maintenance personnel. Additional power variation caused by distributed sources appears as a real problem. Many of small sources in distributed generation are connected to the network through power electronic converters. Since such a converter considerably contribute to the overall cost of investment, they usually install simple converters which are not supply friendly and introduce distortions to the network. This problem is often met in small wind power plants. The number wind power plants in India rise rapidly and their power exceed a few times the highest predictions. Small sources installed all over the country considerably affect the power flows in the network, voltages regulation and frequency regulation. If the distributed sources appear in large number, their influence is significant.

The way the distribution system is operated is changing due to significant penetration of distributed generation (DG).As a result, islanding operation of distribution systems with DGs is becoming a feasible option. Islanding can improve the quality of supply indices and reliability [21, 22]. Many European distribution systems are characterized with a high penetration of fixed speed wind turbine generators and small combined heat and power plants. They can take advantage of this high DGs penetration and operate in islanding mode, during power outage, to increase the over- all reliability of the power supply. However, there are various issues to be resolved.It is known that the increasing penetration of Distributed Generation (DG) implies different technical problems in the operation of distribution systems [23].DG can be responsible for different PQ problems, like poor voltage quality, unwanted protection trips on healthy feeders, and "islanding". Voltage quality, in particular, can become a very critical issue in a distribution system with a relatively large DG amount. Onsite power generation can do a lot of favours for the consumer. The increase of supply reliability and voltage stability are some of the technical aspects. But what is more interesting to the consumer is that the use of on-site distributed energy resources (DER) should bring direct economic benefits [14]. Ministry of New and Renewable Energy, India however, feels that there exist challenges for Renewable Energy based Distributed Generation, some of which are universal and some local, like,

- Inherent intermittent nature of renewable energy sources leading to relatively lower capacity utilization factors Instances of inadequate load needing to couple rural industrial load.
- Relatively high capital costs when compared to conventional power systems which in turn require incentives and financial arrangement.
- For capacity building, promotion and development of energy.
- Requirement of servicing companies for local program implementation.
- Need for adequate mobilization for payment of user charges involving perhaps Non-Government Organizations and local bodies.
- Lack of operation and maintenance services providers is an issue that needs attention.
- Need for developing sustainable revenue / business models.
- Assistance for project preparation.

All form the above mentioned problems can be overcome by implementing new, smart technologies like: smart grid.

IV. CONCLUSION

India is on right track to pursue development of Distributed Generation with the unbundling of power sector utilizing captive and co-generation, besides putting all out effort in harnessing various forms of new and renewable energy. In fact two Ministries of Government of India are involved in the overall progress of Distributed Generation. While Ministry of Power is interested for rural electrification, Ministry of New and Renewable Energy (MNRE) is for the development of DG, thus fulfilling the need of each other. Liberalization of Government policy vis-à-vis support as well as regulatory mechanism in place is helping to create conducive atmosphere to achieve target set in this direction. However, there are challenges that are being attended to with utmost sincerity with Distributed Generation.

REFERENCES

[1] S, Mukhopadhyay, and B. Singh, "Distributed generation — Basic policy, perspective planning, and achievement so far in india," Power &Energy Society General Meeting, 2009. PES '09. IEEE, vol., no., pp.1-7, 26- 30 July 2009
[2] Subrata Mukhopadhyay, “Power Generation and Transmission Planning in India-Methodology, Problems and Investments”, Proc. 2004 IEEE PESGeneral Meeting, Denver, CO, paper no. 424.
[3] “Open Access in Inter-State Transmission”, Central Electricity Regulatory Commission, New Delhi, India, Nov. 2003.
[4] “Electricity Act 2003”, Ministry of Power, Government of India, New Delhi, India, Jun. 2003.
[5] Rangan Banerjee, “Comparison of options for distributed generation in India”, Energy Policy, Elsevier, Oxford, UK, 2006, vol. 34, no. 1, pp. 101-111.
[6]Subrata Mukhopadhyay, “Towards Electricity for All – Transmission Planning for the Growth of India's Power System”, IEEE Power & Energy Magazine, September/October 2007.
[7]www.powermin.nic.in/whats_new/pdf/distributed_gen_final.pdf.
[8] Ministry of Power, 2003a. Annual Report 2002–2003, Government of India, New Delhi
[9] Mukunda, H. S., 1999. A biomass option for enhancing energy security. NIAS Report R4-99, National Institute of Advanced Studies, IISc Bangalore.
[10]Ravindranath, N.H., Hall, D.O., 1995. Biomass Energy, and Environment, A Developing Country Perspective From India. Oxford University Press, New York.
[11] "All India Region wise Generating Installed Capacity of Power". Central Electricity Authority, Ministry of Power, Government of India. January 2013.
[12] Uwe Remme et al. (February 2011). "Technology development prospects for the Indian power sector". International Energy Agency France; OECD.
[13] "Analysis of the energy trends in the European Union & Asia to 2030". Centre for Energy-Environment Resources Development, Thailand. January 2009.
[14] NEW & RENEWABLE ENERGY, Cumulative deployment of various Renewable Energy Systems as on 31/12/2012". Ministry of New and Renewable Energy, Government of India. December 2012.
[15] Nitin Sethi, TNN, 18 November 2009, 12.42am IST (18 November 2009). "1-GW solar power in 2013". Timesofindia.indiatimes.com. Retrieved 2010-11-27.
[16] K. Nigim, Y. Hegazy, Intentional islanding of distributed generation for reliability enhancement, in: Proceedings of the 2003 IEEE PES General Meeting, 2003, pp. 208–213.
[17] F. Pilo, G. Celli ,S. Mocci, Improvement of reliability in active networks with intentional islanding, in: Proceedings of the 2004 IEEE International Conference on Electric Utility Deregulation, Restructuring and Power Technologies, 2004, pp. 474–479.
[18] Challenges of Electric Power Industry Restructuring for Fuel Suppliers September 1998, http://www.eia.doe.gov
[19] A. Siddiqui, C. Marnay, R. Firestone, and N. Zhou, “Distributed Generation with Heat Recovery and Storage”, Lawrence Berkeley, CA, USA, LBNL-58630, July 2005.
[20] G. M. Masters, “Renewable and Efficient Electric Power Systems”, Hoboken, NJ: Wiley, 2004, pp. 231-240.
[21] Blajszczak, G.; Antos, P.; Wasiluk-Hassa, M. “Smart grid accommodation of distributed generationfor more reliable quality of supply” 2011 11th International Conference on Electrical Power Quality and Utilisation (EPQU), pp 1-4, 2011.
[22] Wang Bin; Sun Ming; Dong Baole “The Existed Problems and Possible Solutions of Distributed Generation Micro-grid Operation” Power and Energy Engineering Conference (APPEEC), 2011 Asia-Pacific .pp 1-4 2011
[23] S. Quaia, "Distributed Generation and under load transformers operation: Voltage quality problems and possible improvements," 2010 Int. Symp. Power Electron. Elect. Drives Automation Motion (speedam), pp. 890 – 894, 2010.
[24] J. Marsden, "Distributed Generation Systems: A New Paradigm for Sustainable Energy," 2011 Ieee Green Technologies Conf. (ieee-green), pp. 1 – 4, 2011.
[25] Singh, R. and Sood Y.R, “Transmission tariff for restructured Indian power sector with special consideration to promotion of renewable energy”, Proceedings of 2009 IEEE Region10 Conference, 2009, pp 1-7.
[26] V.Zeljkoviü, N.Lj.Rajakoviü, and S.J.Zubiü, “A method for cost minimization applicable to load centers containing distributed generation,” in Proc. 2009 IEEE Power-Tech Conf., pp. 1-6, Bucharest, Romania, 2009.
[27].R. Shukla “Biomass Energy in India: Policies and Prospects” workshop on Biomass Energy: Key Issues and Priority Needs Organized by International Energy Agency (IEA) Paris, February 3-5.
[28] Sectoral Overview Report on Hydropower Development in India, AHEC, IIT Roorkee, February 2007.
[29] A Parashar, M Shah , P K Das “Impact analysis of distributed generation and RE based distributed generation on Indian economy and economy of BOP” IIT –K 2011.

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