Distributed Power Generation – The Small Hydro Option

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ABSTRACT

Distributed energy resources (Distributed Power) refers to a variety of small, modular power-generating technologies that can be combined with energy management and storage systems and used to improve the operation of the electricity delivery system, whether or not those technologies are connected to an electricity grid.

Distributed Power systems range in size and capacity from a few kilowatts up to 50 MW. They comprise a portfolio of technologies, both supply-side and demand-side, that can be located at or near the location where the energy is used.

To meet the country’s need for high-quality, reliable electricity, distributed energy resources (Distributed Power) offer a faster, less expensive alternative to the construction of large, central power plants and high-voltage transmission lines.

Installing Distributed Power at or near a customer load can avoid the need to upgrade transmission and distribution lines to handle the extra power requirements.

Added to this, the Government of every country strives hard for the upliftment of the rural sector. Some of the key issues of rural sector are

a) Increasing demand
b) High tail end T & D Losses
c) Lower quality of power and
d) Lack of employment opportunities.

The proven and successful way to address some of the above issues is through Distributed Generation.

Small hydro technology offers the right solution in addition to being a sustainable source. Small independent projects in the hills across small streams or in irrigation canals offer the right locations in the rural areas.

The mature technology with high efficiencies, environment friendly projects, high energy density source, simple, reliable and flexible operations, good social benefits around the project and lastly wide range in terms of capacity, makes small hydro a distributed generation source of choice.

1 ELECTRICITY SECTOR

- Has Come a Long Way Since Independence
- Installed Capacity Gone up from 1700 Mw to Over 100,00 Mw – 60 Fold.
- T & D Network Has Gone up By 200 Fold
- Rural Electrification Nearly 100%
- IP Sets Electrification Gone up By 550 Fold.
- T & D Loss Has Gone up from 15% Average to 30% Average.
- Electricity Utilities Have Become Weak and Unstable Financially Without External Aids.
- Energy Metering Biggest Casualty.
- Billing Hardly 40-45% of Energy Purchases.
1.1 Major Loopholes in Revenue Stream

- High Transmission and Distribution Losses
- Non Technical Losses/Pilferage
- Irrational Agricultural Tariff Policy
- Unmetered Sales – No Relation to Consumption.

The Sector Can Be Self-Reliant Subject to Tackling the Above Issues Even Partially.

1.2 Electricity Sector – Future

- GDP Growth for Next Decade – 7 – 8% Per Annum
- Electricity Sector Growth Rate – 10% Per Annum
  - Reform to Grow
  - Grow and Reform
- Electricity Sector Reforms – in the Right Direction

1.3 Next Five Years

1. Increase Installed Capacity and Network Penetration
2. Reduce Transmission & Distribution Losses.
3. Meter All Consumers
4. Rationalise Tariffs – Consumer Pays the Cost.

1.4 Where to Start Improvements

- From the Highest Consumer Category Which is at the Same Time Least Remunerative – Agricultural Sector
- Where Network Density is High and Consumer Density is Low – Rural Areas.

1.5 Why Rural Sector

- Rural Sector Demand is Increasing at a Higher Rate Than Other Areas.
- T & D Loss Highest in Rural Sector, Being at Tail ends of Network.
- Low Quality and Reliability of Power in Rural Areas - Detrimental for Existing Users and New Investments.
- Lack of Employment Opportunities in Rural Areas Limits, Ability to Pay for Services – Vicious Cycle.

A Proven and Successful Way to Address Some of the Above Issues is through Distributed generation.

1.6 What is Distributed Power

Refers to a Variety of Small Modular Power Generation Technologies That Can Be Combined With Energy Management and Storage Systems That Can Improve the Electricity Delivery System.

Distributed Power Systems Range in Size and Capacity from a Few Kilowatts to 50 Mw.

1.7 Need for Distributed Power

- Electricity Delivery System is Highly Strained.
Demand for Power Continuously Escalating.
Quality Problem On the Increase.
Large Central Plants Take Years to Come
Matching Investments in Transmission Systems Required.
Environmental Impact of Large Stations Costly to Mitigate.
Distributed Power Offers Quicker Alternatives.
Addresses Some of the Constraints Mentioned Above.

1.8 US – DOE Report - 1999

Distributed Utility Perspectives – Major Applications
- Electricity System – 46%
- Deferral of Transmission and Distribution Upgrades – 32%
- Power Quality & Reliability – 17%

2 MAJOR BENEFITS of DISTRIBUTION GENERATION

2.1 Consumer Side:
- Better Power Reliability and Quality.
- Lower Energy Costs.
- Energy and Load Management.
- Combines Heat and Power Capabilities
- Environmental Benefits- Clean Energy With Less Emissions.

2.2 Grid Side Benefits:
- Reduced Energy Loss in Transmission Lines.
- Reduced Or Deferred Line and Substation Upgrades.
- Optimal Use of Existing Grid
- Improved Grid Reliability.
- Higher Energy Conversion Efficiencies than Central Stations.
2.3 Distributed Power Technologies

- Renewable energy
  - Small hydro
  - Wind
  - Solar photovoltaic
  - bio mass
  - Cogen
  - Fuel cells
- Combustion turbine – generators
- Micro turbine - generators
- Engine – generator sets

One of the Best Options for Rural Distributed Power is through Renewables Using Local Resources.

2.4 Distributed Generation-Characteristics

- Small Capacity
- Integrates Load Centric Modular System With Central Plants
- Improved Power Quality
- Voltage Support
- Control Flexibility
- Reduces Transmission Losses
- Defers T&D Upgrades
- Increases Efficiency
- Cleaner Technology
- Provides Power to Rural Areas More Quickly

2.5 Rural Sector- Energy Needs

- Small to Medium Loads
- Predominantly Agricultural/Domestic Loads-Needs VAR / PF Improvement
- Better Voltage- (Suffer from Low Voltage Conditions)
- Generation through Available Resources
- Simple Operations- Quick Start Ups

2.5 Rural Sector- Social Needs

- Employment for Unskilled Majority
- Employment for Semi Skilled / Skilled At least for the Available Few
- Better Infrastructure- Road, Primary School, Drinking water, Street Light, Sewerage System

2.6 T&D System - Demands

- Reduction in Transmission Losses
- Reduction in Thefts
- Better Asset Utilizations
- Savings in Capital Investments
2.7 Typical Examples of Design

- Small Independent Projects in the Hills, Where Small Streams Are Available. These Are Mostly of Medium and High Head Utilizing Small Discharges

- Small Installations in the Plains and Other Regions Which Utilize Water Regulated for Other Purposes. Eg. Irrigation Canals, Foot of Small Dams Etc. These Are Usually of Low Head Utilizing High Discharges

3 ADVANTAGES of SMALL HYDRO

- Highest energy density renewable resource, Easy to Harness
- Non-Consumptive Generator of Electrical Energy.
- Environmental Friendly - Non Polluting
- Located in Remote areas enhancing economic opportunities for local residents
- Operations Simple, Reliable, Flexible, Quick Start
- Technology very mature, Efficiencies above 90%
- Sizes range from few Kilowatts to several Megawatts
- Economic feasibility far Superior as compared to other energy sources using finite fuels
- Leads to Social benefits in and around Project area.
- Distributed Generation

3.1 Improvement in Quality of Power

- Lesser Burn Out of Ip Motors
- India-12 Million Ip Sets
- Karnataka 1.3 Million Ip Sets
- Rewinding Expense Per Year Rs. 1500-1200 Per Set
- Savings Karnataka- Rs. 250 Cr. Per Annum
- Could Be Taken As Tariff Instead of As Maintenance Cost

3.3 Uses Available Resources (Flowing Water, Wind, Biomass Construction Materials)

- Tremendous Value Addition from Non Consumptive Water/Wind & Biomass Waste to Electrical Energy
- Adds to the Industrial GDP of Rural Sector
3.4 Employment for Unskilled Majority

- Hydro Projects Have Huge Civil Construction Components Which Predominantly Use Unskilled Labour

Eg. for a 2 Mw, Rs 1100 Lacs Project the Requirement was Average 200 Persons for 18 Months

3.5 Permanent Employment for Skilled Persons

- About 15 to 18 (Fitters, Electricians Etc.) + Security & Gardening Contracts

3.6 Better Infrastructure

In Most of Our Projects Some Or All of the Following Were Carried Out
- Build/Widen Village Approach Roads and Make Them All Weather Roads Including New Culverts/Bridges
- Bus Shelters
- Increased Bus Service
- Building New Schools (1000 Children Benefit)
- Adopt and Upgrade Infrastructure in Existing Govt. Schools
- Street Lights for the Main Village Road
- Participate in Swasti Grama Yojana Programme (4 Villages Till Date). Big Budget Spread Over Three Years
- Our Vehicles Always Available for Emergencies in the Village

3.7 Environmental Benefits

- Mitigation of Green House Gases- a Great Concern Worldwide
- the Co2 Gas Emission for Producing 1 Kwh is Approximately 1.2 Kg from Coal Based Stations
- the Co2 Emission Saved Even from 2 Mw Small Hydro Station With 50% PLF is Around 12000 Tonnes Per Year
- in the Us the Penalty for Co2 Emission is USD 5-10 Per Tonne.
- If Trading Were Permitted a 2 Mw Station With 50% PLF Would Have Benefited By Upwards of Rs.60 Lacs Per Year.

3.8 Reduction in Transmission Losses

- Transmission Loss from Central Stations to the Delivering Sub Station Are As High As 10-12% Distributed Generation Helps in Saving This Huge Amount

3.9 Better T&D Asset Utilization
-When Long Lines Are Constructed
Provisions Are Kept for Future Load
Requirements Which May Not Be
Utilized for a Long Time.
- In the Sample Case Shown, the Conductor Can Carry Upto 20 Mw Comfortably But What is Passing is Only 5 Mw. It is Under Utilised By 75%

3.10 Savings in Capital Investments
- With Stations Being Load Centric
Investments in Transmission Can Be Drastically Reduced Because of Shorter Distances and Economic System Design to Actual Utilisation.

4 CONCLUSION
- The Vision Statement for Electricity Sector is Power for All By 2012.
- The Anticipated Capacity Addition By 2010 is 100,000 Mw.
- The Country’s Potential On Renewables, Technically Feasible for Implementation As On Date, is More Than 25,000 Mw
- The Policy Statement of Ministry of Non Conventional Energy is 10% of Energy through Renewables By 2012.
- The Power Ministry Target for T & D Loss is 16% in the Next Few Years.
- The Ministry of Environmental and Forest is committed to Limit Co2 Emissions in Future As a Fall Out of Kyoto Protocol.
- The Ministry of Petroleum is Striving Hard to Decrease Dependency On Oil Imports – Improve Energy Security.
- The Ministry of Rural Development Has Taken up Various Employments Generation Programmes to Improve the Economic Status of the Rural Population.

All This Points to Only One Direction for the Electricity Sector. - Distributed Generation through Renewables at Least to the Extent of 10 – 12% of Electricity Generation at All Times.

RECOMMENDATION

All States in their Future Plans Should Include 15% of Capacity Additions On the Basis of Distributed Power through Renewables.

Distributed Generation _

Answer to Electricity Network Growth with Efficiency and Economy.