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Transmission of Power to the Island Using HVDC

(From Indian continent to Lakshadweep island)

B. Vijayalakshmi[1], C. Ram Kumar[2]
Assistant professor, ECE, Sri Ramakrishna Institute of Technology[1]
Assistant professor, ECE, SNS College of Engineering Coimbatore, India[2]

Abstract

HVDC transmission is more effective and economically cheaper where bulk power is to be transmitted over long distance. Hence the surplus power from a remote place can be exported to the needy place at cheaper rate. The HVDC system require only one transmission wire and the ground return or seawater can be used as an another line. The Lakshadweep Island is located at faraway place from the northeast part of India where the surplus power is available. The seawater for return path is available. The diesel for D.G set is transported from Indian mainland through ship where lot of economy is lost only for transportation. In this paper the transmission of HVDC from Indian mainland to Lakshadweep is analyzed at economically cheaper rate.

Keywords

HVDC, DG Set, Bio mass, polar link

1. Introduction

The Lakshadweep group of islands in the Arabian Sea consists of 10 small and medium size inhabitant islands and several uninhabited ones lying about 400 kms off the south-west coast of mainland India. The main occupations are fishing, fish processing and tourism. The islands are generating power from diesel generators, wind generators, biogas plants and solar generating units. They are generating 9MW of power by using diesel generator for which diesel fuel is transported from main-land; 250 KW biomass gasified are currently under installation in addition to that a part of power is generated from solar and wind energy. Our idea is to transmit the power from Indian continent to Lakshadweep by using HVDC transmission system. To reduce the transportation cost and to be economic one.

2. Location

The Lakshadweep group of island in the Arabian Sea is one of the major groups of island in the India. It is lying between 8 to 12 degree north latitude and 71 to 74 degrees east longitude. About 400 km off the south west coast of mainland India as shown in figure given below.

Fig 2.1: Location of India

3. Energy Requirements

In Lakshadweep Island 10 habited islands are there which need power for survival in the island. For that LED (Lakshadweep Electricity Department) generates power by diesel generator, wind, solar energy and also from biomass. The requirement of power is doubled in 2000-01 as compared to 1986-87 at mean time the generation of power also doubled to attain the requirement as shown in the table-1.

Table 1: Electricity scenario

Island	Electricity Consumption (Thousand Kwh/Year)		Dg Set Capacity (Kw)	
	1986-87	2000-4	1986-87	2000-04
Minicoy	1266	4395	750	1800
Kalpeni	396	140	269	750
Andrott	873	274	750	1250
Agatti	391	181	318	1210
Kavaratti	1422	4013	1000	1800
Amini	420	174	269	1034
kadamat	257	131	188	750

kiltan	228	88	204	510
Chelat	180	60	160	430
Bitra	23	7	48	24
bangaram	--	2	74	74
Total	5456	9464	3956	9368

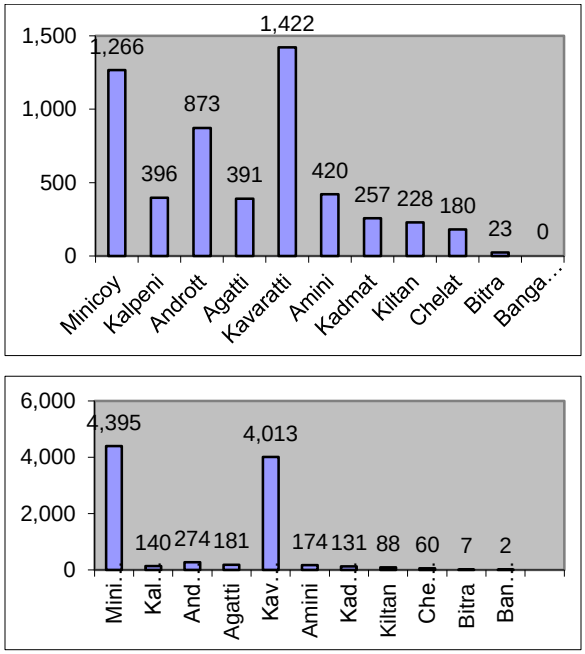

Fig 1: Graph 1: Electrical Consumption

They have another alternate way of generation is from Biomass generation. The Lakshadweep island is full of coconut & palm tree which provide biomass for generation. The availability of raw material in the island is as given below.

Table 2: Biomass and kerosene consumption for heat

Island	FISH used (tons/yr)	BIO MASS (tons/yr)	KEROSENE (Kilo litre/yr)
Minicoy	675	472	210
Kalpeni	55	39	100
Andrott	--	--	120
Agatti	3125	2184	80
Kavaratti	225	157	110
Amini	37	26	110
kadamat	22	15	80
kiltan	210	147	40
Chelat	317	222	30
Bitra	495	346	12
bangaram	--	--	0
Total	5162	3608	892

4. Bio Mass

The total energy source available in the island for consumption is as given below in table 4. The 9 MW of power is overcome by diesel generator, 1MW of power is overcome by biomass and other conventional source also full fills some of the little requirement. The diesel fuel is carried to the island from the main land in 200-liter oil drums and stocked at the power plant.

Table 3: Electricity generation mix

Island	DG Sets Capacity (KW)	SPV Power Plants (kWp)	WEG (KW)	Gasifier (KW)
Minicoy	1800	100		
Kalpeni	750	100		
Andrott	1250	100		
Agatti	1020	100		
Kavaratti	1800	100	20	250
Amini	1034	100		
kadamat	750	150		
bangaram	74	60	20	
Total	9368	1035	40	250

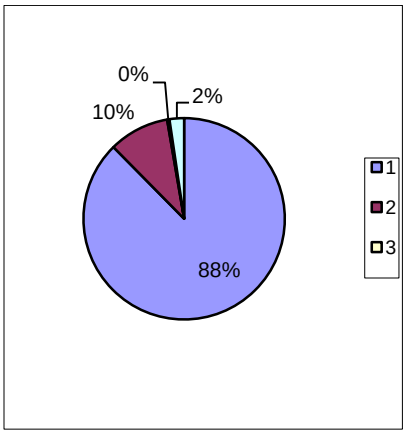

Fig 4.1: Graph 2

5. Solar Energy

The main source of generating power is solar energy the energy attained may vary with respect to the wind flow at that time if the wind flow is high the solar radiation attained is reduced. The wind speed may vary with respect to the month. In the month of June, July and August the speed of wind is high so solar radiation attained is reduced at that time wind mills are used for power generation. The details of solar and

wind energy in different month is as given below in the Table 4.

Table 4: Solar and Wind resource data for Agatti

Month	Solar Radiation ($KWh/m^2/day$)	Monthly Mean Wind Speed (m/s)	Weibull parameter
January	5.127	3.4	1.20
February	5.765	3.7	3.20
March	6.270	3.2	2.40
April	6.043	3.9	3.50
May	4.984	4.3	2.10
June	3.926	8.9	3.30
July	3.779	8.9	4.90
August	4.268	8.4	4.60
September	4.946	5.9	3.00
October	4.862	3.7	2.00
November	4.727	3.4	1.70
December	4.672	3.1	2.60
Average	4.932	5.1	2.90

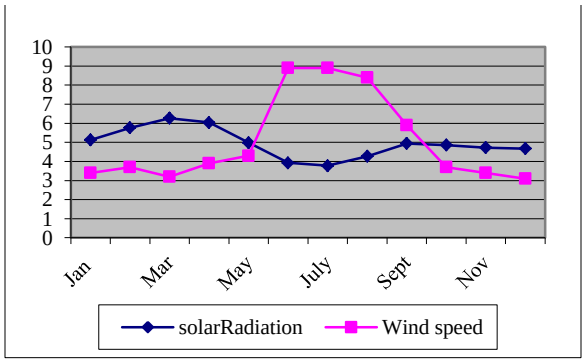

Fig 5.1: Graph 3: Solar and Wind resource data

With respect to the above details there may be switching between the solar and wind source utilization for generation.

6. Idea for Transmitting

In the present world the demand of power is keep on increasing. The customer is to be satisfied by supplying the quality power at a cheaper rate. The quality of power means the voltage, frequency should be almost constant, the harmonic content should be less and the power factor should be nearly unity. But in the transmission system there are lots of disadvantages in AC supply transmission. In the latest trend HVDC transmission plays an important role and has so many advantages than HVAC transmission. The advantages are discussed in detail in this paper. In HVDC transmission the generation and utilization is as usual in A.C only but in the transmission side from the sending end the A.C supply is converted into DC with the help of rectifiers and then the DC supply is transmitted and in the receiving end the D.C. supply is again converted back into AC with the help of inverters, then this AC is distributed to the consumers. The HVDC transmission is very much effective for bulk power over long distance. The HVDC is economical over 800 km transmitting for bulk power. There five types of HVDC Transmitting system.

1. Monopolar link
2. Bipolar link
3. Homopolar link.
4. Back to back link.
5. Multi-terminal DC link.

6.1. Monopolar link

This link has only one conductor, usually of negative polarity and uses ground or seawater as the return conductor. The negative polarity is preferred on overhead lines due to lesser radio interference. Fig 6.1 shows Mono Polar Link.

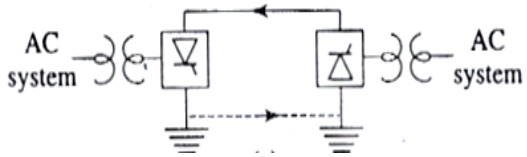

Fig 6.1: Monopolar link

6.2. Homopolar Link

A homo polar link has two conductors, all having the same polarity and always operates with ground as the return conductor. If a fault develops on one conductor, the converter equipment can be reconnected so that the healthy conductor can supply more than half the rated power. Such a reconnection is very complicated in a bipolar scheme and therefore, a homo polar scheme is preferable to a bipolar scheme provided continuous ground return does not pose additional problems. Fig 6.2 shows a homo polar link.

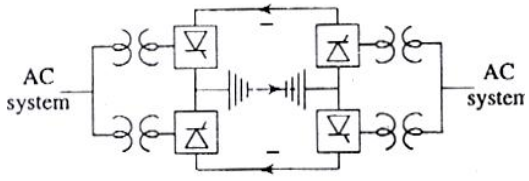

Fig 6.2: Homopolar Link

6.3. Cost Calculation

With respect to the parametric value the cost of installation may be calculated.

Table 5: Monopolar vs. Homopolar

PARAMETER	MONOPOLAR	HOMOPOLAR
Length (L)	800 km	800 km
No of conductors	1	2
Power (P)	9 MW	9 MW
Voltage (V)	± 100 KV to ± 600 KV	± 100 KV to ± 600 KV
Current (I)	± 90 A to ± 15 A	±90 A to ± 15 A

$P = (V \times I)$ [1]

$V = (I \times R)$

$I = (V / R)$ [2]

Sub [2] in [1]

$P = (V^2 / R)$

$R = (V^2 / P)$

$R = \{(\rho \times L)/a\}$

$a = \{(\rho \times L)/R\}$

Where P – Power (W)

R – Resistance (Ω)

I – Current (A)

V – Voltage (V)

A – Area (m^2)

ρ – Specific resistance (Ω /m)

From the above expression we can obtain the area of conductor to be used for different voltage from that we can calculate the cost of the conductor based on the company we selected. This is tabulation for the conductor size to be used for different voltage.

Table 6: Voltage and size of conductor data

VOLTAGE (KV)	RESSTANCE (Ω)	AREA (mm^2)	RADIUS (mm)
100	1111.11	1.224	19.738
150	2500	0.544	13.159
200	4444.44	0.306	9.8692
250	6944.44	0.1958	7.8946
300	10,000	0.136	6.5795
350	13,611.11	0.09918	5.6395
400	17,777.77	0.0765	4.9346
450	22,500	0.06044	4.3861
500	27,777.77	0.04896	3.9477
550	33,611.11	0.04062	3.5887
600	40,000	0.034	2.897

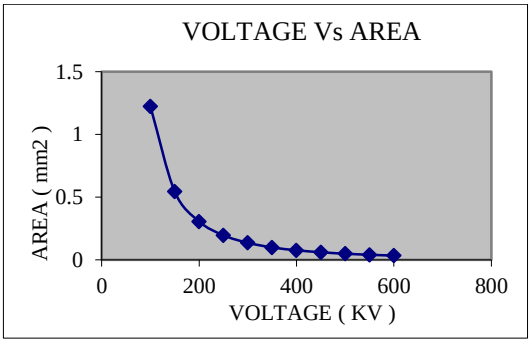

Fig 6.3: Graph 4: Comparison of voltage and area

7. Implementation

The main aim of this paper is to transmit the surplus power available in northeast region to Lakshadweep. The distance is around 600 km from the Bangalore. The surplus power from northeast region is transmitted to Bangalore through national grid and from Bangalore the power can be transmitted to Lakshadweep. The mainline can be laid through sea as an underground cable and the sea return can be used as a return path. The DC supply can be converted to AC through inverter in the Lakshadweep and can be distributed to the consumer. This will work out very cheap and the surplus power can be effectively utilized.

8. Advantages

1. Transportation cost of diesel from Indian mainland is reduced by using HVDC system.
2. These systems are economical for transmitting bulk power over long distance, say above 550 km.
3. There is greater power transmission per conductor and the DC line is cheaper as it requires two conductors instead of three and hence costs no insulator and towers are less.
4. Each conductor in DC line can be operated as an independent circuit.

9. Disadvantages

1. The overall cost increases, particularly for line lengths below 500 km, because of requirement of converters, filters, reactive power compensators.
2. Overload capacity of HVDC converters is low.

10. Conclusion

It has been discussed in this paper about the advantages of HVDC over HVAC system. It has more advantages when bulk power is transmitted over long distance. The surplus power at northeast region of India can be effectively transmitted to Lakshadweep through Bangalore at cheaper rate. The diesel, which is used for diesel generator set, can be reduced by which the power cost can be reduced. So the power can be exported to Lakshadweep Island through Bangalore from Indian mainland using HVDC.

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References

[1] V.V.N. Kishore, R.P.Sukumaran, Potential for renewable energy utilization in Lakshadweep Islands, TERI 1988.
[2] C.M.Ahmed, Anna Mani, V.Rangarajan, "Solar radiation over India", pp 302-345, 2003.
[3] Anna Mani, V.Rangarajan, "Wind Resource Survey for India," Vol.3.
[4] R.Hunter,G.Eliot, "Wind diesel systems", 2005.
[5] M. L. Soni, P.V. Gupta, U.S. Bhatnagar, A. Chakrabarti, "A Text Book on Power System Engineering" Dhanpat Rai & CO – 1998.
[6] K.R. Padiyar, "HVDC Power Transmission System", Wiley Eastern Limited, 1992.
[7] S.S.Vadhera "power System Analysis and Stability",Khanna Publishers,1997.

B. Vijayalakshmi is working in Sri Ramakrishna Institute of Technology as Lecturer in the department of ECE. She received the M.E degree in communication Systems from Sri Krishna college of Engineering and Technology, Coimbatore under Anna University Chennai in 2012 and B.E degree in Electronics and communication Engineering from Raja College of Engineering and Technology, Madurai under Anna University, Chennai in 2010. She had presented 7 national conferences and 5 international conferences in various fields. She is an active member of IETE. She has done the project in the area of embedded systems, and wireless network. Her area of interest is computer networks and wireless communication.

C. Ram kumar is working in SNS college of Engineering as Assistant Professor in the department of ECE. He received the M.E degree in communication Systems from Sri Krishna college of Engineering and Technology, Anna University Chennai in 2012 and B.E degree in Electronics and communication engineering from SRM Easwari Engineering College, Anna University, and Chennai in 2010. He had presented 14 national conferences and 7 international conferences in various fields. He is an active member of IETE, E-360 & IEEE. He has done the project in the area of embedded systems and wireless network. His area of interest is computer networks, micro-processor, optical communication, Microwave Engineering and wireless communication.