360 MW Generation of Wind Power & Evacuation To 400KM

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Abstract— Power demand had a drastic raise in past few decades. To fulfill the power demand, transmission line becomes an vital part of power system. As power generating units are at a far distant from user, transmission of power to consumer is only possible via transmission and distribution lines. The manual method of transmission line design involves tedious calculation and relies on the knowledge and experience of designer. Computational design of transmission line gives faster result and wide vision of the probable solution. C #based software is developed so as to calculate all electrical parameter required for transmission line design.

Index Terms— Wind turbines, Evacuation, Generation, Cascaded design.

I. INTRODUCTION

As a newly developed form of power generation, wind power has become an effective way to deal with energy shortages and environmental & moreover it is also important to keep several factor were designing it. One of the place in Kenya near Nairobi a place called lake Turkana, were there is great and vast abundance of wind power ie the place experiences continuous wind flowing all the years ,and also it is of quite good velocity of wind. Overhead lines are essential to transmit power from one place to other and also for interconnection purposes. Interconnected lines are used to transfer power in case of emergency. In order to match the mechanical and electrical characteristics of the overhead conductors to the environmental conditions, climatic details must be first collected and analyzed Lake Turkana Wind Power (LTWP) is a company incorporated in Kenya (East Africa) to develop energy sources from wind. After intensive studies, and viability assessment, the company has identified the Lake Turkana region as having great potential of wind power generation in Kenya. Lake Turkana is situated in the North Western part of Kenya, approximately 600 km from Nairobi, the capital city of Kenya. Initially the Company proposes to install 360 wind turbine generators each with an installed capacity of 890 KW. The generated power will be evacuated at 33 KV and then stepped up in two stages of 132 KV and 400 KV. There will be a 400 KV substation at Lake Turkana Initially it is propose to place an 405 wind turbine, there layout, designing and geographical parameters are studied. Different parameters for transmission line such as type of the conductor, there layout, sizing, corona effect & designing of the wind turbine layout as per area allotted and environmental condition is to be designed.

The paper proposes an Computational design of transmission line gives faster result and wide vision of the probable solutions For EHV trans- mission line design, certain areas are given more importance, such as corona loss, electric and magnetic fields.

II. MODEL OF THE WIND TURBINE

1. Rated Electrical Data:

The V52-890 kW wind turbine is able to operate in fixed power factor mode with a power factor range in the interval from 0.98 capacitive to 0.95 inductive measured on the 690 V generator side and with 100% of rated active power. It is possible to choose other power factor values; however, with reduced active power The V52-890 kW wind turbine is also able to operate in fixed reactive power mode. In the fixed reactive power mode, the wind turbine will generate or absorb reactive power up to 500 kVAr, when the generator stator winding is coupled in delta; however, with decreased reactive power close to the rated power output. The table shows the Electrical data for WTG.

Table1: Electrical data for WTG

Electrical DATA FOR WTG	
Power	890 Kw
Generator type	Asynchronous with wound rotor, slip-rings and VCS
Building size	400
Degree of protection	IP54
Insulation class	F/H
Voltage	690 VAC
Frequency	50 Hz
Number of poles	4
Generator power	1

factor, default(cosϕ)	
Generator power factor (cosϕ)	0.98 capacitive to 0.95 inductive
Available reactive power	+172/-279 kVAr

2. LAYOUT OF THE TURBINE

Figure1 show the Basic one line diagram of the wind turbine. It is assumed the turbines will be installed in 9 rows of 45 turbines. The turbines will be installed with a distance of 100 m. The rows will be about 1 km apart. To be calculated are the life time cycle costs are when each turbine is equipped with a 1000MVA transformer in each turbine, one transformer installed in the middle for 3 turbines, one transformer for 5 turbines

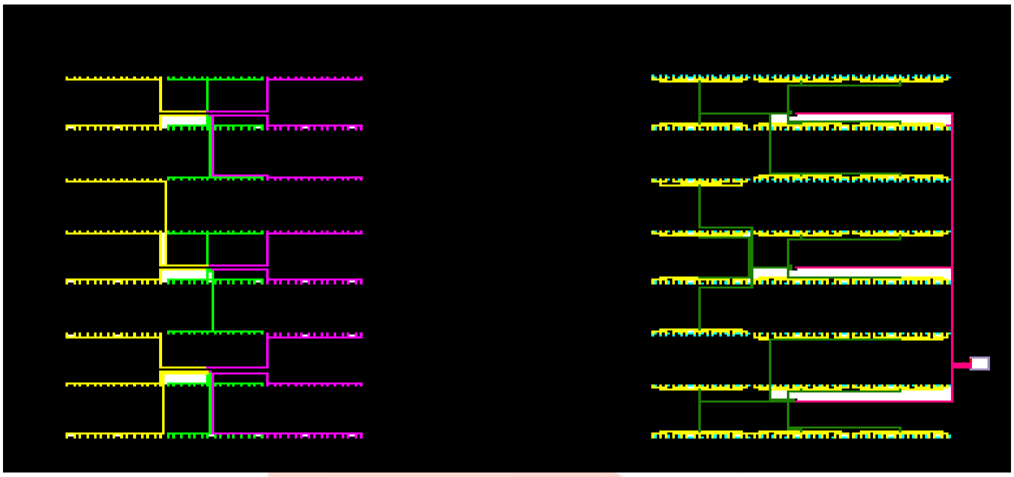

Figure1: Layout of Turbine

III. SOFTWARE MODELLING

In modern engineering work, computer programming is used for developing software. For electrical calculation of EHV transmission line, C# with dot net framework 2.0 (Visual Studio 2005)is chosen to develop program. Program is an user friendly tool and it represents result and data in graphical form, which enables easy understanding to an individual.

1. Main Screen

Main screen of program provides various calculation options. It shows option for Current capacity calculation, Electrical calculation for Double circuit vertical configuration, Single circuit vertical configuration and Single circuit horizontal configuration.

Figure2. Main screen

2. Ampacity

A typical screen of program is shown in Fig 3 Program used for calculation of Ampacity.

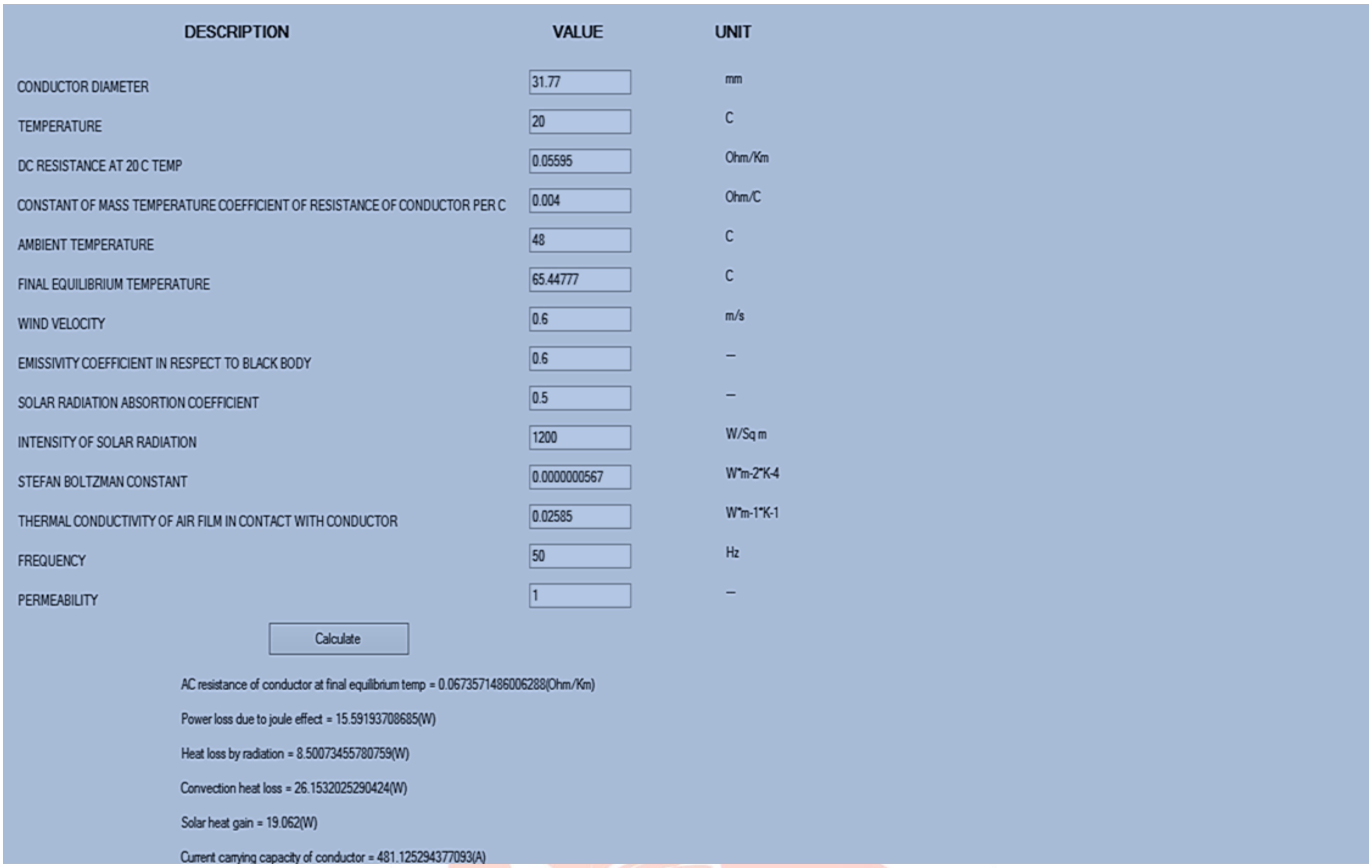

Figure3. Ampacity Calculation

3.Inductance And Capacitance

A typical screen for inductance and capacitance calculation is shown in Fig 4 .

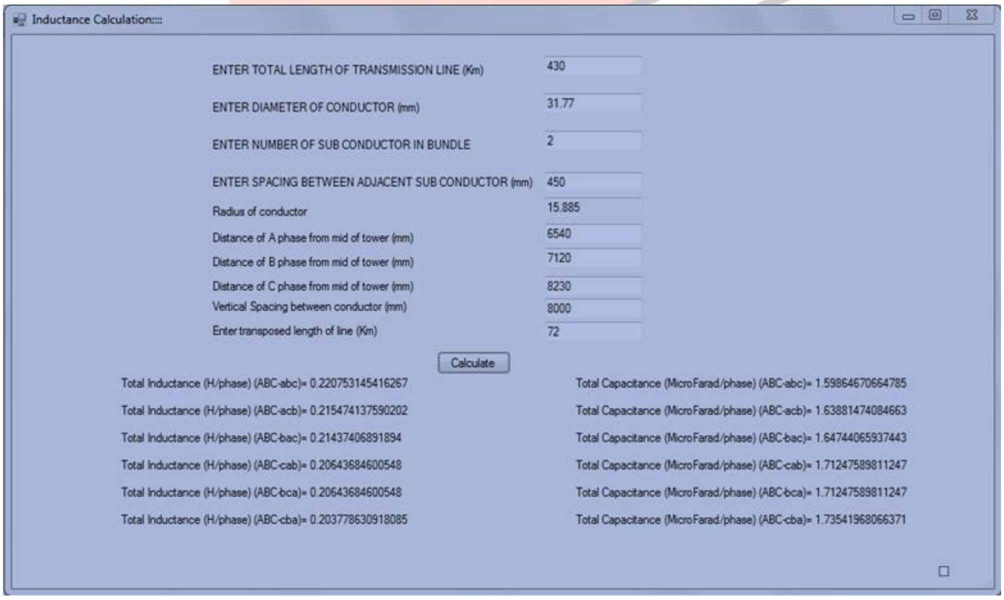

Figure4 Inductance & Capacitance

4.ELECTRICAL CALCULATION FOR DOUBLE CIRCUIT CONFIGURATION

A typical screen for transmission line design of double circuit is shown in figure 5.

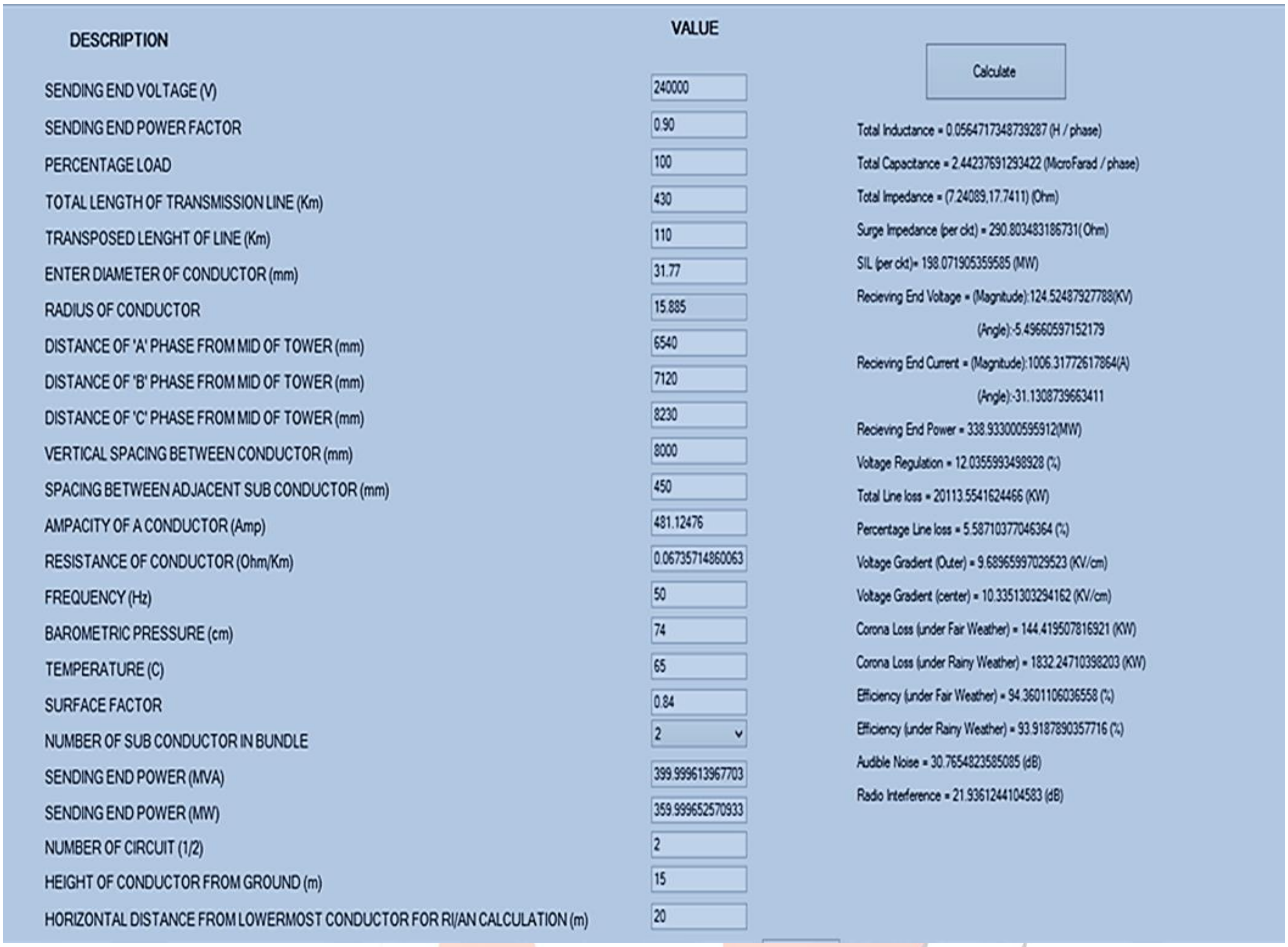

Figure5 Double Circuit Configuration

IV. RESULTS

Results are carried out with reference to the results obtained after designing and computation for all the alternatives.

1. INPUT DATA

Input Parameters		
Description	Unit	ACSR Moose
Conductor Diameter	Mm	31.77
Temperature	0C	20
DC resistance at 200C temperature	Ω/K m	0.05595
Constant of mass temperature coefficient of resistance per 0C	Ω/0C	0.004
Ambient Temperature	0C	48
Final Equilibrium Temperature	0C	65.45
Wind velocity	m/s	0.6
Emissivity co-efficient in respect to black body	Ke	0.6
Solar radiation absorption co-efficient	γ	0.5
Intensity of solar radiation	W/m2	1200
Stefan-Boltzmann constant	W/(m2 ∗ K 4)	5.67 ∗ 10−8
Thermal conductivity of air film in contact with conductor	W/(m ∗ K	0.02585
Frequency	Hz	50
Permeability	μ	1

Table 2 Input data for calculating Ampacity of ACSR moose conductor

Description	Unit	Value
Sending end voltage	V	240000
Sending end power factor	Pf	0.9
Percentage load	%	100
Total length of transmission line	Km	430
Transposed length of line	Km	110
Sending end power	MW	360
Conductor diameter	Mm	31.77
Distance of A phase from center of tower	Mm	6540
Distance of B phase from centre of tower	Mm	7120
Distance of C phase from center of tower	Mm	8230
Vertical separation	Mm	8000
Distance between adjacent sub conductor	Mm	450
Number of sub conductor Ampacity at t20 C temp per phase	Amp	2
per phase Resistance of conductor at t20C temp	Ω/K m	481.13
Frequency	Hz	50
Barometric pressure	K	0.0674
Temperature	0'C	74
Surface factor		75

Table 3: Input data for electrical calculation of ACSR moose conductor

2. **OUTPUT DATA**

Table 4 shows the result for twin conductor, double circuit ACSR moose conductor. Results are considered for power transfer of 360MW at 400KV voltage and for transmission length of 430 Km.

Description	Unit	Value
Total Inductance	H/phase	0.05134
Total Capacitance	µ/phase	2.220
Impedance	Ω	7.24+16.13i
Receiving End Voltage (Magnitude & Angle)	KV	124.524, -5.4966
Receiving End Current (Magnitude & Angle)	A	1006.31,-31.1333
Receiving End Power	MW	338.93338
Voltage regulation	%	12.05
Total Line loss	KW	20113.60
Percentage Line loss	%	3.35
Max. outer surface Voltage gradient	KV	16.15
Max. center surface Voltage gradient	KV	17.23
Fair weather corona loss per circuit	KW	861
Foul weather corona loss per circuit	MW	19
Efficiency under fair weather	%	96.36
Efficiency under foul weather	%	90.88
Audible Noise	dB	57.33
Radio Interference	dB	45.3
Sag at operating temperature & no wind	m	12.49
Sag at operating temperature & 0.36 full wind	m	10.36
Sag at operating temperature & full wind	m	6.25
Tension at operating temperature & no wind	Kg	3210
Tension at operating temperature & 0.36 full wind	Kg	3867
Tension at operating temperature & full wind	Kg	6409

Table 4: Calculation result for ACSR moose conductor

V. CONCLUSION

In this paper all the necessary calculation for transmission line design is shown and two conductors viz: ACSR Moose and ACCC Delhi are compared. Program is developed for easy calculation of current carrying capacity of conductor, for electrical calculation of Double circuit transmission line, Single circuit transmission line for both vertical and horizontal orientation. In this program nearly all the configurations can be considered.

ACSR Moose conductor is a standard conductor which is used for 400 KV transmission line. This conductor can be considered where operating temperature doesn't exceed beyond 750C and where initial cost has to be kept minimum.

REFERENCES

[1] IS 398 (Part 5)(1992): Aluminum conductor for overhead transmission purposes- Specification

[2] IEC 1597 (1995): overhead electrical conductors-Calculation methods for stranded bare conductors.
[3] IS 802 (Part 1 / Sec 1) (1995): Use of structural steel in overhead transmission line towers - code of practice.
[4] Richard E. Kenon, "EHV Transmission Line design opportunities for cost reduction."IEEE Transactions on Power Delivery, Vol. 5, No.2, April 1990.
[5] "Transmission line Reference book for 345KV and above". 2nd ed. California: Electric Power Research Institute (EPRI), 1982.
[6] "Transmission line manual", Central Board of Irrigation and Power (CBIP), New Delhi, Publication No. 268 Chapters 3,4,5.
[7] Rakosh Das Begamudre,"Extra High Voltage AC Transmission Engineering", 3rd edition. New Delhi, New age International Publisher, 2006, pp22-167.
[8] John J. Grainger, Wiiliam D. Stevenson,Jr., "Power System Analysis", Singapore, McGraw-Hill, 1994, pp. 141-230.
[9] S. Rao, "EHV-AC and HVDC transmission practice", Khanna Publishers, pp. 824-883.
[10]J. Reichman, "Bundled conductor voltage gradient calculations", IEEE Trans- action, August 1959
[11]IEEE Std 738(1993): IEEE Standard for calculating Temperature relationship of bare overhead conductors.
[12]DICABS conductors, technical catalogue, diamond cables Ltd. [18] Sterlite conductors, technical catalogue, Sterlite technology Ltd.
[13]TPEC (Takalkar Power Engineers and Consultants Pvt. Ltd. (India)), Lake Turkana Spec/Part1 Gen.spec.1.
[14]S.M. Takalkar, "Basic about power transmission system and bare conductor", Chapter 1.