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IMPROVEMENT OF EFFICIENCY OF TRANSMISSION LINES WITH SIMULTANEOUS AC-DC TRANSMISSION

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ABSTRACT

The power system is dependent on a stable and reliable control of active and reactive power to keep its integrity. Loosing this command may lead to a system collapse. It isdifficult to load the long extra high voltage ac lines against their thermal limits because of volatility incident in the power system. The aim of this paper is to enhance the transient steadiness of power scheme by establishing simultaneous AC– DC power transmission through a transmission line. With the scheme suggested in this paper, it is more likely to load these lines very close to their thermal limits. The benefit of simultaneous ac-dc transmission isfor up gradation of transient steadiness and dynamic steadiness . Dampout oscillations have been established. Simulations have been done in MATLAB software package (Simulink Model)

Keywords: EHV, simultaneous AC–DC power transmission.

INTRODUCTION

In latest years, environmental, right-of-way (Row), and financial anxieties have delayed the building of a new transmission line. The demand of electric power has shown stable development but geographically it is proposed through a single circuit ac transmission line.

In these proposals Mono-polar dc transmission with the growing load centers but at isolated locations. The ground as return path was used[1]-[4]. There were certainregulatory policies, ecological acceptability, and the limitations due to use of ground as return path economic anxieties involving the accessibility ofMoreover, the instantaneous value of each conductorpower are some of the factors that work out thevoltage with respect to ground becomes higher by thelocation.amount of the dc voltage, and more discs are to be added.Now due to steadiness concerns, the transmissionadded in each insulator string to withstand thisof the available power through the living ac lines hasincreased voltage. However, there was no change inan upper limit.the conductor separation distance, as the line-to-line[5]and[6].Therefore, it is tough to load long extra highvoltage remains unchanged. In this paper, thevoltage (EHV) ac lines to their thermal bounds as afeasibility study of conversion of a double circuit acsufficient margin is kept against transient in-line to composite ac–dc line without altering thesteadiness & dynamic steadiness as well as to damporiginal line conductors, tower structures, andout oscillations in power system.insulator strings has been presented. In this scheme,In order to efficiently utilize the available energy,the dc power flow is point-to point bipolarnew concepts come into existence considering thetransmission system. Clericiet al. [7] suggested thesystem availability and security.conversion of ac line to dc line for substantial powerThe improvement of effective ways to useupgrading of existing ac line. However, this wouldtransmission scheme close to its thermal limit hasrequire major changes in the tower structure as wellcaptivated much attention in recent years.as replacement of ac insulator strings with highThe progress in the area of power electronics hascreepage dc insulators.already started to leverage the power industry .

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PROPOSED METHODOLOGY

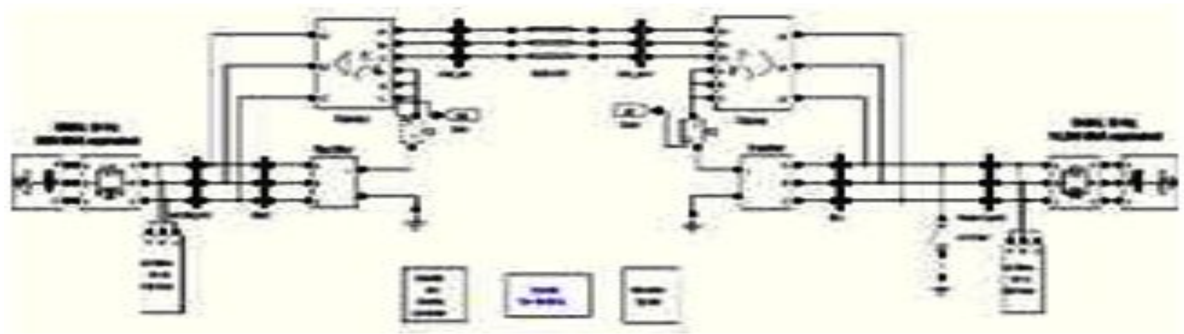

Figure 1 : Basic model for simultaneous AC-DC transmission

The novelty of our proposed scheme is that thetransformer which is obtained by the rectifier bridge,power transfer enhancement is achieved without anyagain it is reconverted to ac by the inverter bridge atalteration in the existing EHV ac line. The mainthe receiving end. The inverter bridge is againobject is to gain the advantage of parallel ac–dcattached to the neutral of zigzag connected winding oftransmission and to load the line close to its thermalthe receiving end transformer. But for higher supplylimit.

voltage. We can also use Star connected primaryA. High Voltage AC Transmissionwindings in place of delta-connected windings. BothIndustrial-minded countries of the world require a3 –phase ac and dc power is carried out by singlevast amount of energy of which electrical energycircuit transmission line. A part of the total ac power

forms a major fraction. The world has alreadyis converted into dc by the winding of the transformerconsumed major portion of its natural resources and isconnected to rectified bridge, at the sending end.looking for sources of energy other than Hydro andThen at the receiver end, the tertiary windingThermal to cater for the rapid rate of consumptionconnected to the inverter bridge, again convert thewhich is outpacing the discovery of new resources.same dc power into ac. Each conductor of the lineThis will not slow down with time and therefore therecarries one third of the total dc current along with acexists a need to reduce the rate of annual increase incurrent Ia. But the return path of the dc current isenergy consumption by any intelligent society ifground. The saturation of transformer due to dcresources have to be preserved for posterity. Thiscurrent flow id handled by Zigzag connected winding.requires very high voltages for transmission. The veryA high value of reactor, X d is used to reducerapid stride taken by development of dc transmissionharmonics in dc current.since 1950 is playing a major role in extra-long-distance transmission, complementing orsupplementing E.H.V. ac transmission. They havetheir roles to play and a country must make intelligentassessment of both in order to decide which is bestsuited for the country's economy.B. Problems posed in using HVACa.Increased Current Density because ofincrease in line loading by using series

capacitors.b [8] .Use of bundled conductors.c.High surface voltage gradient onconductors.d.Corona problems: Audible Noise, RadioInterference, Corona Energy Loss, CarrierThe ac current flow will be restricted between theInterference, and TV Interference[9].Zigzag connected windings and the three conductors.High electrostatic field under the line.of the transmission line in the nonappearance of zero.Switching Surge Over voltage's whichsequence and third harmonics or its multiplebecause more havoc to air-gap insulationharmonic voltages. If this these components ofthan lightning or power frequencyvoltages are present then they only be able to producevoltages.a negligible current through the ground due to high ofg.
Increased Short-Circuit currents andXd.possibility of Ferro resonance conditions.h.Use of gapless metal-oxide arresters[10]-[11].The expressions for ac voltage and current and thereplacing the conventional gap-typepower equations in terms of A,B,C and DSilicon Carbide arresters, for bothconsiderations of each line when the resistive drop inlightning and switching-surge duty.transformer winding and in the line conductors due toi.Shunt reactor compensation and use ofdc current are neglected can be written as:series capacitors, resulting in possible subsynchronous resonance conditions and Sending end voltage

$V_S = AV_R + BI_R$(1)
high short circuit currents.

The DC power is injected to the neutral point ofSending end current:the zigzag connected secondary of sending end

Total transmission line loss is
$P_L = (P_S + P_{dr}) – (P_R + P_{di})$(2)

Sending end power
$P_{S+JQS} = (-V_SV_R^*) / B^* + (D^*/B^*)V_S^2$(10)

being the rms ac current per conductor at any pointof the line, the total current for each conductor becomes
$I = \text{sqrt}(I^2_\alpha + (I_d / 3)^2)$ and $P_L = 3I^2R$

Receiving end power
$P_{S+JQS} = (V_SV_R^*) / B^* - (A^*/B^*)V_R^2$(11)

If the rated conductor current corresponding to its(4) allowable temperature rise is I-th and

The expressions for dc current and the dc power at thebeing less than unity, the dc current as
$I\alpha = 3 \times (\text{sqrt}(1 – x^2)\, I_{th}$

time when the ac resistive drop in the line and transformer are neglected
Dc current
$I_d = (V_{dr}Cos\alpha – V_{di}Cos\Upsilon) / (R_{er} + (R/3) – R_{ci})$

The total current I in any conductor is asymmetricalbut two natural zero-crossings in each cycle in currentwave are obtained for the instant worth of each conductor voltage with respect to the ground becomes the dc voltagewithPower in inverter

$P_{id} = V_{di} \times I_d$
a superimposed sinusoid ally varying ac voltagehaving rms valueand the peak value being
$E_{max} = V + 1.414\, E_{ph}$(6)

Power in rectifier
$P_{dr} = V_{dr} \times I_d$

The electric field produced by any conductor voltagepossesses a dc component superimposed withsinusoid ally varying ac component. However theinstant electric field polarity changes its sign twice inWhere R is the line resistance per conductor, andcycle if.Therefore, the highercommutating resistances,and firing andcreep age distance requirement for insulator discsextinction angles of a rectifier and inverterused for HVDC lines are not required.respectively andare the maximum dcEach conductor is to be insulated forbut thevoltages of a rectifier and inverter side respectively.line to line voltage has no dc component andValues ofandare 1.35 times line to line. Therefore, conductor totertiary winding ac voltages of the respective sides.Reactive powers vital by the converters are

$Q_{di} = P_{di} \tan \Theta_I$
$Q_{dr} = P_{dr} \tan \Theta_r$
$Cos\, \Theta_I = (Cos\, \Upsilon + Cos\, (\Upsilon + \mu_i)) / 2$
$Cos\, \Theta_r = (Cos\, \alpha + Cos\, (\alpha+\mu_r)) / 2$

conductor separation distance is determined only byrated ac voltage of the line.Assuming
$V_d/E_{ph} = k$

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$P_{dc}/P_{ac} = (V_d * I_d) / (3 * E_{ph} * I_\alpha * Cos\Theta)$
$= (k * sqrt(1 - x^2) / (x * Cos\Theta)$
$P_t = P_{dc} / P_{ac} = (1 + [k * sqrt (1 - x^2)] / (x * Cos\Theta)) * P_{ac}$(8)

Whereandare commutation angles of inverter(14)and rectifier respectively and total active and reactivepowers at the two ends are
$P_{st} = P_s + P_{dr}$ and $P_{rt} = P_s + P_{di}$
$Q_{st} = Q_s + Q_{dr}$ and $Q_{rt} = Q_s + Q_{di}$

In case of faults in the transmission scheme, gatesignals to all the SCRs are jammed that to the bypasss are released to protect rectifier and inverterbridges. CBs are then tripped at both terminals toisolate the complete system. As mentioned earlier, if

RESULTS

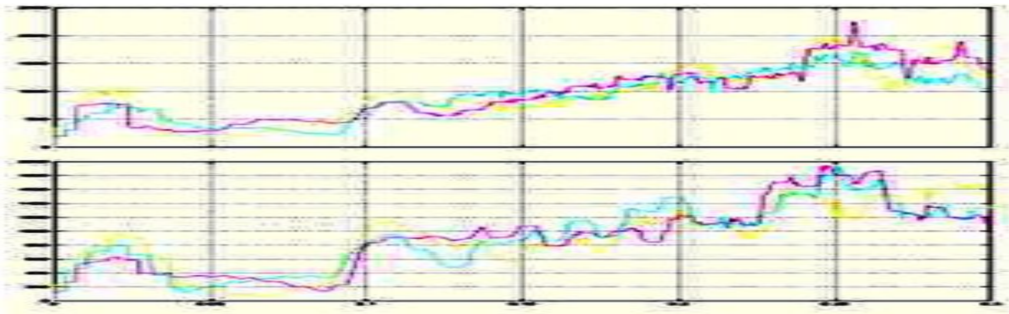

Figure 3: Sending and receiving end currents RMS

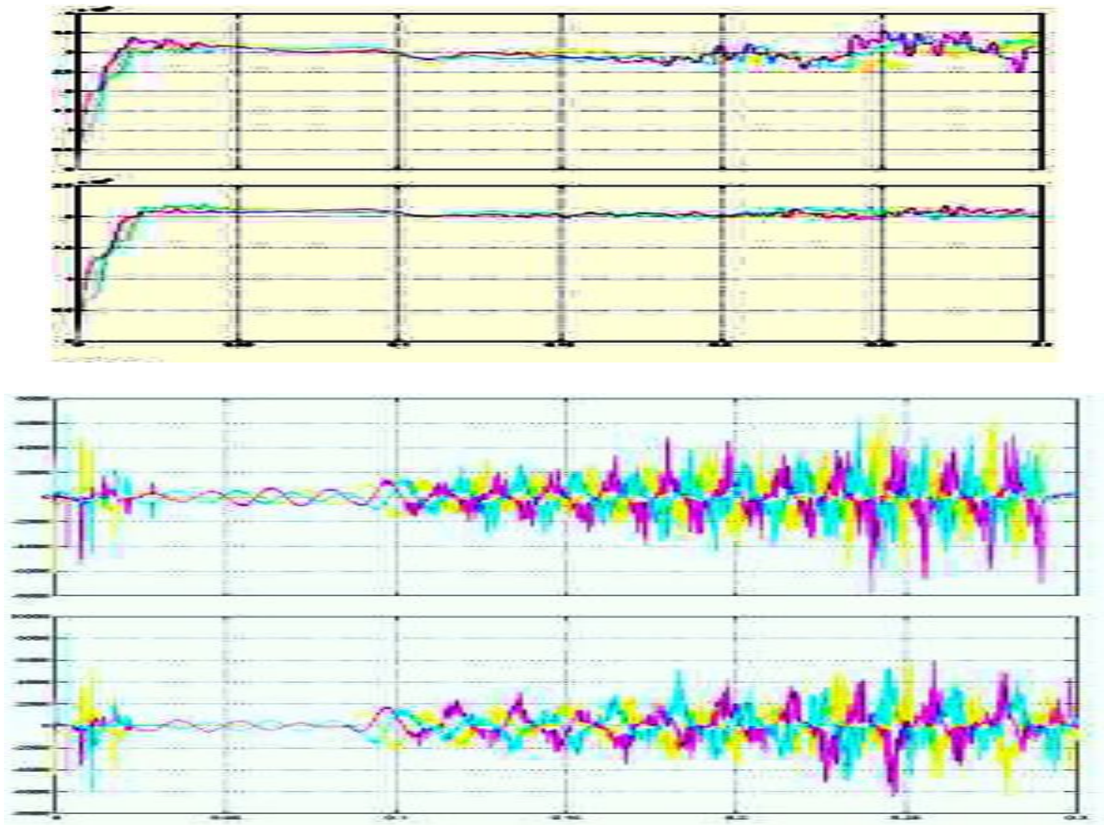

Figure 4: Sending and receiving end currents

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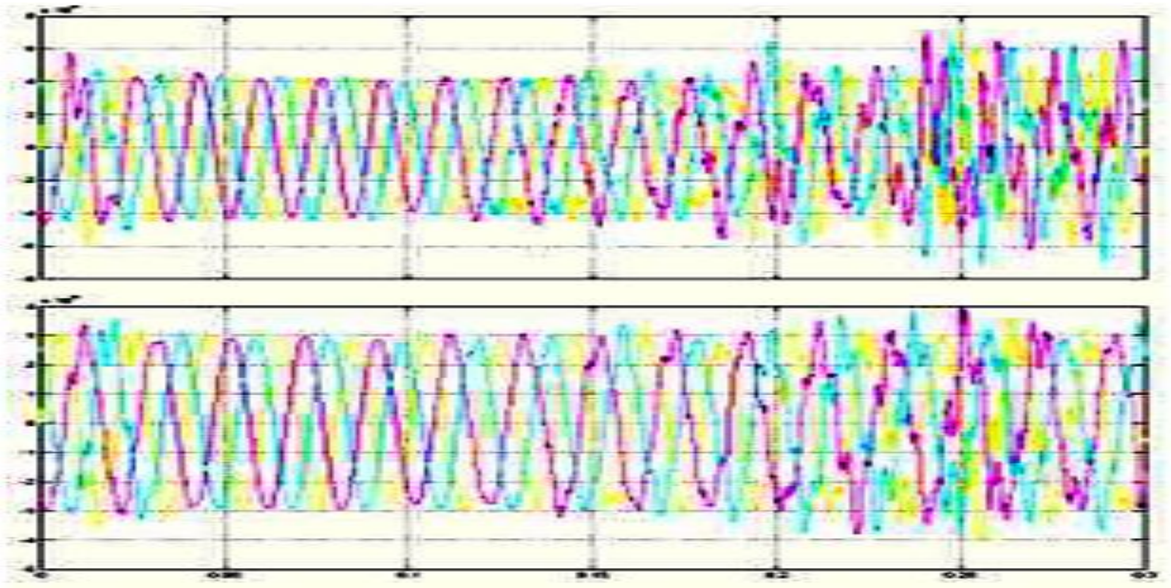
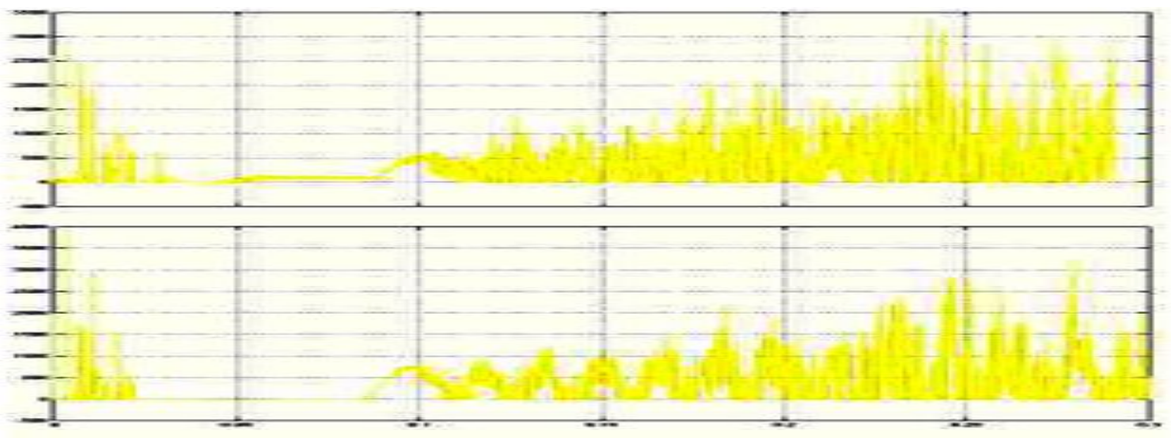
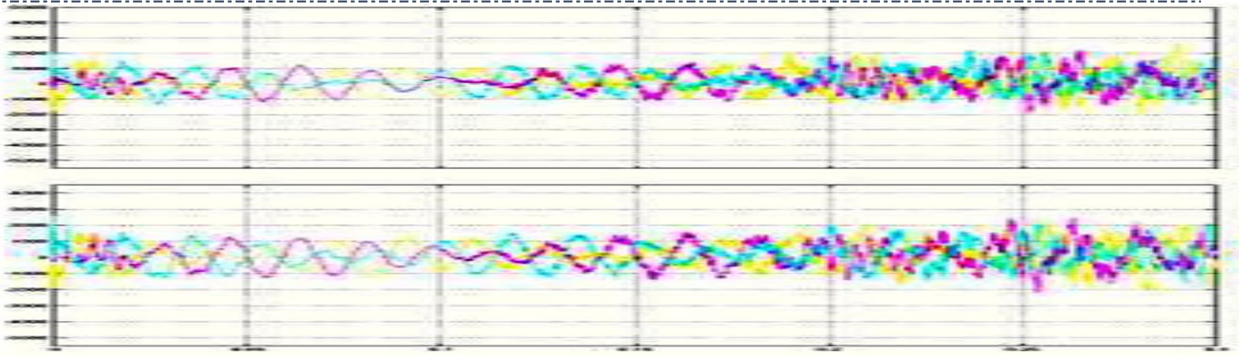
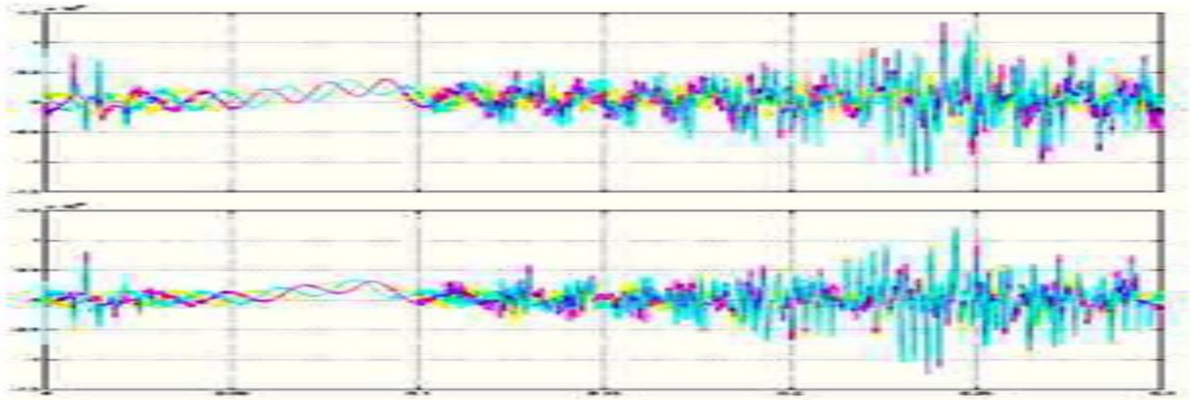
CBs connected at the two ends ofthe transmission line interrupt current at naturalcurrent zeroes and no special dc CB is essential. Todouble-check proper procedure of transmission lineCBs tripping signals to these CBs may only be givenafter feeling the zero crossing of current by zerocrossing indicators. Otherwise CB's attached to thedelta edge of transformers may be utilised to separatethe fault. Saturation of transformer core, if any,because of irregular fault current decreases line sidecurrent however rises the primary current of thetransformer. Delta edge CBs, planned to cleartransformers terminal faults and winding faults, treatthese faults easily.Suitable values of ac and dc filters as utilised inthe HVDC system may be attached to the delta sideand zigzag neutral correspondingly to filter out the upper harmonics from dc and ac supplies. However,filters may be omitted for low values ofAtneutral terminals of zigzag winding dc current andvoltages may be measured by adopting commonmethods used in HVDC scheme. Accepted cvts as utilised in EHV ac lines are utilised to assess accomponent of transmission line voltage. The overlaiddc voltage on the transmission line does not touch theworking of cvts. Linear couplers with high air-gap core may be engaged for the estimation of acconstituent of line current as a dc constituent of linecurrent is not adept to saturate high air-gap cores.Electric signal handling circuits may be utilized todevelop a composite line voltage and currentwaveforms from the signals gained for dc and accomponents of voltage and current. Those signals areused for protection and control purposes.









CONCLUSION

The EHV ac lines, because of integral transientstability difficulty cannot be loaded to their supremethermal boundary. With the present simultaneous ac-dc transmission it is practicable to load these linesclose to thermal edges specified in the data sheets.For the specific system researched, there is asubstantial increase in the load-ability of the line. Theline is laden to its thermal limit with thesuperimposed dc current

REFERENCES

[1] H. Rahman, B.H. Khan, Enhanced power transfer by simultaneous transmission of AC–DC: a new FACTS concept, in: IEE Conference on Power Electronics, Machines and Drives (PEMD 2004), vol. 1, 31 March, 2 April 2004, Edinburgh, 2004, pp. 186–191.

[2] H. Rahman, B.H. Khan, Power upgrading of double circuit ac transmission line by simultaneous ac–dc power transmission, in: Proceedings the IEEE, PES, PowerIndia,2006,doi:10.1109/POWERI.2006.163262.

[3] H. Rahman, B.H. Khan, Power upgrading of transmission line by combining ac-dc transmission, IEEE Trans. Power Syst. 22 (1) (2007)459466,doi:10.1109/TPWRS.2006.887895 (Paper ID No. TPWRS-0864-2005)

[4] T. Vijay Muni, T. Vinoditha and D. Kumar Swamy,“ Improvement of Power System Stability by Simultaneous AC-DC Power Transmission” International Journal ofScientific& Engineering Research Volume 2, Issue 4, April-2011.

[5] N.G. Hingorani, L.K. Gyugyi, Understanding FACTS Concept and Technology of Flexible A.C. Transmission Systems, IEEE Press, 2000.

[6] L.K. Gyugyi, Unified power flow concept for flexible A.C. transmission system, in: IEE Proceedings, July 1992, p. 323.

[7] A. Clerici, L. Paris, and P. Danfors, HVDC conversion of HVAC line to provide substantial power upgrading,‖ IEEE Trans. Power Del., vol. 6, no. 1, pp. 324–333, Jan. 1991.

[8] PrabhaKundur-power system stability and control Tata Mcgraw Hill edition, New Delhi 1993, 11th reprint 2011.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

[9] N.A.Vovos, G.D. Galanos, Transient stability of ac–dc system, IEEE Trans. Power Apparatus Syst. PAS-98 (4)(1979) 1375–1383.

[10]K. P.Basu and B. H. Khan, "Simultaneous ac-dc power transmission," Inst. Eng. (India) J.-EL, vol. 82, pp. 32– 35, Jun. 2001.

[11]SriramKondiparthi, M. Pravee, Ramu M., I.E.SNaidu, "Power Transfer Enhancement in Transmission Line by Combining AC – DC Transmission", InternationalJournal of Engineering Research and Applications (IJERA), ISSN: 2248-9622, Vol. 1, Issue 2, pp.194-201, July 2011.