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Improvement in Power Transfer Capacity of Existing Grid by Using Simultaneous AC-DC Power Transmission

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Abstract: This paper presents the tactic and operation of simultaneous ac-dc power transmission. We all know that in transmission if long further high voltage (EHV) ac lines loaded to their thermal limits thus great deal of power loading results giant instability happens in transmission that affects the total power grid. It's terribly troublesome operation to load transmission lines to their enough margins of thermal limits. By mistreatment this methodology of planned during this paper, it'll be attainable to load transmission lines to maximum values of their thermal limits. During this methodology transmission lines or allowed to hold ac beside dc supply superimposed thereon. The conductors bear ac on with the dc supply. This system gives conversion of double line ac transmission into composite parallel ac-dc transmission system thus having the advantage to transient ability, dynamic stability and damp out oscillation. In this paper the Simulation operation perform in MATLAB software package having Simulink software.

KEYWORDS: EHVAC Transmission, EHVDC Transmission, Facts Power System Stability, Transmission Efficiency, Alternating Current and Direct Current Calculation, MATLAB, Simultaneous ac-dc Power Transmission.

I.INTRODUCTION

We know that whole world need the big quantity of power with low loss as a result of year by year the expansion of all industries, industrial and residential a part of the planet demanding power for his or her growth. The demand of electrical power having steady growth power is however the provision of power typically not obtainable at the increasing load centres and remote locations. On the environmental acceptableness, and the economic issues additionally giving the provision of energy square measure the factors that crucial of these locations. Here due to stability concerns, the transmission having obtainable energy through its existing ac lines having in higher limit. Therefore it's terribly tough to load long further high voltage (EHV) ac lines to their thermal limits as given correct margin that unbroken against transient instability. The trendy world having the things that is full utilization of obtainable energy that applying the new concepts to the recent power transmission theory with a read the system availableness and their security. The versatile ac transmission has supported the application of power electronic technology that existing ac transmission, the role of power natural philosophy improves stability and potency to succeed in power transmission near its thermal limit. Here we tend to square measure talking about coincident ac–dc power transmission that was earlier planned through one circuit ac transmission line with uni-polar dc link with ground as come path was used for his or her transmission operation .The Major limitations of ground as come path is as a result of the very fact that the utilization of ground might corrode any gold material if it comes in its path. The conductor voltage with regard to ground 3 becomes higher as a result of addition of dc voltage on ac line, hence additional dielectric discs ought to be adscititious with every insulator string in order that it will face up to this increased voltage. However condition is that the conductor separation distance was unbroken constant, because the line-to-line voltage should be unchanged [1]. This paper provides United States of America the strategy of converting a double circuit ac line into composite ac–dc power line while not fixing the initial line conductors, dielectric strings and tower structure. Economic factors like the high value of long lines and revenue from the delivery of extra power give sturdy incentives

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to explore all economically and technically possible suggests that of raising the soundness limit. The event of effective ways [3].Basic proof justifying the practicability of simultaneous AC–DC transmission has been reportable in these papers. During this paper, the advance of transient stability by utilization of the inherent intrinsic short-run overloads capability Of the DC system and apace modulating the DC power born-again into coincident AC–DC line. One machine infinite bus connected by a double circuit AC line, converted for simultaneous AC–DC power transmission has been studied. The transmission angle is varied up to case of simultaneous AC–DC power transmission system. So that causes the effective performance and increasing the efficiency of power transmission capability of power system.

II. TRANSMISSION SCHEMES & THEIR TRENDS

We know that the planet needs an outsized quantity of energy of that power utilized by whole world. We've already consumed major portion of its natural resources like coal, fuels, fossil oil and that we ar yearning for renewable sources like star and wind energy apart from Hydro and Thermal to cater for the fast rate of consumption. it'll not impede with year and thus there exists a necessity to scale back the speed of annual increase in energy consumption by any intelligent society if resources got to be preserved for posterity. It needs terribly high voltages for transmission. The terribly fast stride taken by development of dc transmission since 1950 is taking part in a significant role in extra-long-distance transmission, complementing E.H.V. ac transmission. They need roles to play and a rustic should build intelligent assessment of each so as to determine that is best suited to the country's economy. The high voltage ac transmission offers the big quantity of corona loss, electrical phenomenon and use of bundled conductor and compensation need for power transmission.

Advantages of HVDC

(1) No corona loss.
(2) No necessary use of bundled conductors.
(3) No surface voltage gradient on conductors.
(4) It doesn't having the matter of hear able Noise, Radio Interference, Carrier Interference, and television Interference.
(5) High electric field below the road.
(6) It prevents by enlarged Short-Circuit currents and risk of Ferro resonance conditions.
(7) It doesn't need any compensation or use of any electrical phenomenon circuit.

III. METHODOLOGY

Here for the operation of synchronic ac-dc power flow through a twin circuit ac line we wish to feature the dc provide with ac provide. In these methodology we have a tendency to area unit mistreatment Line commutated 12-pulse rectifier bridge for HVDC and therefore the dc power is connected to the neutral purpose of the zigzag electrical device of causation finish {and we have a tendency to|and that we} get the recovered back to ac once more by mistreatment the road commutated 12-pulse bridge electrical converter on the receiving finish aspect therefore we get the each a part of the facility ac furthermore as dc on the receiving finish aspect which means a similar provide on causation finish aspect the electrical converter bridge is additionally connected to the neutral of zigzag connected winding of the receiving finish electrical device to recover the dc current by mistreatment the electrical converter. The dc current on the neutral purpose is dividing on all the 3 phases and so every conductor of every line carries one third of the whole dc current with ac current superimposed on transmission conductor [8].The division of current altogether phases depends upon the resistance of conductor and so the worth of dc current depends upon resistance of conductor Since the resistance is equal altogether the 3 phases of secondary coil of zigzag electrical device and therefore the 3 conductors of the road, the dc current is split altogether the 3 phases.

The conductor of the second line provides come back path for the dc current to flow. If we have a tendency to area unit talking regarding the saturation of electrical device then the saturation of electrical device attributable to dc current are often removed by mistreatment zigzag connected winding at each ends of electrical device.
So the production of fluxes by the dc current (Id / 3) flowing through every winding of the core of a zigzag electrical device provides equal magnitude and provides opposite in direction and therefore cancels.

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At any instant of your time the whole dc flux becomes zero. Thus, dc saturation of core is removed. Here higher worth of reactor accustomed harmonics in dc current. within the absence of harmonics (3rd) or it's multiple and nil sequence, beneath traditional in operation conditions, the ac current flowing in every line gets restricted between the zigzag connected windings and therefore the conductors of the line [9].

The presence of those parts area unit manufacturing negligible current through the bottom attributable to higher worth of Xd. Here if we have a tendency to area unit presumptuous constant current management of rectifier and constant angle of extinction management of electrical converter, the equivalent circuit of the model considering single ac line beneath steady-state in operation condition. The ac current come back path is denoted by risk lines.

The second line acts because the comeback path for dc current, and every conductor of the road carries (Id / 3) {along with along aspect in conjunction with beside at the side of together with} the ac current per section and therefore the most values of rectifier and electrical converter side dc voltages area unit V_{dro} eleven and V_{dio} severally. So that area unit helpful values to analysis the increasing of potency on transmission lines.

IV. MATHEMATICAL EXPRESSION

Here the strategy to resolve the equations unit given below that we tend to tend to unit neglecting the resistive voltage drops and thus the role of dc currents giving a set of algebraically expressions for ac voltage and current, and together giving for active and reactive powers in terms of A, B, C, D parameters of each line. These are additionally given by:

Es = AEr + BIr---------- (1)
Is = CEr + DIr ---------- (2)
Ps + jQs = -Es*Er*/B* + D*Es2/B* ---------- (3)
Pr + jQr = Es*Er/B* - A*Er2/B* ---------- (4)

Hence neglect the resistive voltage drops among the zigzag transformers and thus the tie lines, the dc current Id, dc power Pdr and Pdi of each rectifier and convertor is additionally expressed as:

Id= [Vdro Cosϕ - Vdio Cos ϕ] / [Rcr +Req - Rci] ---- (5)
Pdr = Vdr*Id ---------- (6)
Pdi = Vdi*Id ---------- (7)

Reactive powers required by the converters are:

Q dr = Pdr *tan ϕ r -------- (8)
Q di = Pdi *tan ϕ i --------- (9)
cos_r = [cos ϕ + cos(ϕ + μr)]/2 ------ (10)
cos_i = [cos ϕ + cos(ϕ + μi)]/2 ------- (11)

μi denotes the commutation angles of convertor and μr denotes the commutation angle of rectifier and thus the whole active and reactive powers at every the ends are:

Pst = notation + Pdr and Prt = Pr + Pdi ---------- (12)
Qst = Qs + Qdr and Qrt = Qr + Qdi ------- (13)
Here transmission loss for each line is:
Pl = (Ps + Pdr) – (Pr + Pdi) ---------- (14)
Ia is that the RMS AC current through the conductor at any a neighbourhood of the road, the RMS current per conductor of the road becomes:

I = [Ia2 + (Id/3)2]1/2;
Power loss for each line = PL 9 3I2R.

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The total current I in any of the conductors is offset from zero. presently by setting Infobahn current through the conductor an equivalent as its thermal limit (Ith):
Ith = [Ia2 + (Id/3)2]1/2 ---------- (15)

Let Vp be per half RMS voltage of the initial ac line. Together permit us to deem about Va be the per half voltage of the ac a part of of synchronic ac-dc tie line with constant dc voltage Cupid\'s itch composed on it. As a result of the insulators unit unchanged, the peak voltage among the two cases ought to be equal. If the rated conductor current with relevancy its allowable temperature increase is Ith and Iowa = X * Ith; X (too however unity) so the dc current becomes:
Id = 3 x (sqrt (1-x2)) Ith -------- (16)

The price of voltage in conductor that is section to ground voltage will written as a result of the dc voltage contagion with a composition of curving varied ac voltages that has RMS worth Eph and additionally the height price being:
Emax = V + 1.414 Eph

Electric field that of the composite AC-DC line that consists of the sphere created by the dc line that feeding power and additionally the ac line that creating a superimposed results of electrical fields. this may be merely see that the sharp changes in field polarity happens that changes its sign doubly during a} very single cycle if (Vd/Eph) & lt; 1.414.Here we've got a bent to envision that the gap for dielectric discs utilized in HVDC lines. Each conductor has to be insulated for the utmost E_{max} but the actual fact is line to line voltage has no component of dc voltages and ELL(max) = a combine of.45 Eph. Therefore, we've got a bent to return back to the conclusion that conductor to conductor separated distance is discovered only by ac voltage of the road in situ of the complete superimposed one.

Detailed analysis of the filter and instrumentation networking that unit required for the planned theme and together short current ac vogue for safeguarding theme is out the scope of gift work, but preliminary analysis qualitatively given below says that sometimes used techniques in HVDC and AC composite system is also adopted solely for this purpose. utterly totally different values of ac filters and dc filters unit utilized in HVDC system and additionally these may even be connected to the delta side of the device and zigzag neutral severally to strain higher harmonics fourteen that's (n*p+1)th order and also the (n*p)th order from dc and ac provides. Moreover, filters together may even be omitted for very low values of contagion and Id. among the neutral terminals of zigzag device winding dc current and dc voltages is also discovered by incorporating common ways in which unit utilized in HVDC system.

Standard CVTS or physical phenomenon voltage device as utilized in EHV ac lines to measure stepped down AC component of line voltage. The composite ac-dc voltage among the road will the operative of covets. Linear couplers that has high air-gap core may even be used for activity ac component of line current as a result of the dc component of line current cannot saturate high air-gap cores.

V. UNDER FAULTY CONDITION

Under fault conditions the effort of causing facet voltage and receiving facet voltage suddenly dips of original wave type once fault is cleared. The effort and receiving end currents rises to an explicit spike then recovers step by step. Commonly the voltage of across the rectifier and convertor dips on the prevalence of fault whereas this level spikes to a lower place fault conditions. The on high of results unit of measurement obtained by using one line to ground fault at intervals the distributed parameters for the one circuit line model.
The results keep nearly similar to a lower place dc fault. To a lower place fault conditions the reactive power demand can increase as is inferred from the graph. As a result of the reactive power is used at intervals the circuit therefore the reactive power at the receiving end side is down to a negative price. The one line circuit model uses ground as come path.
Hence use of unipolar dc link for coinciding ac-dc transmission will create threats to the instrumentation located nearby within the ground since victimisation ground as come path will corrode the metallic material if it's in its path.[7] Another factor is that the sluggishness within the system is removed, if we tend to contemplate AN EHV line and on prevalence of a fault the transient response of the system as an example the voltage profile or this or the abrupt surge

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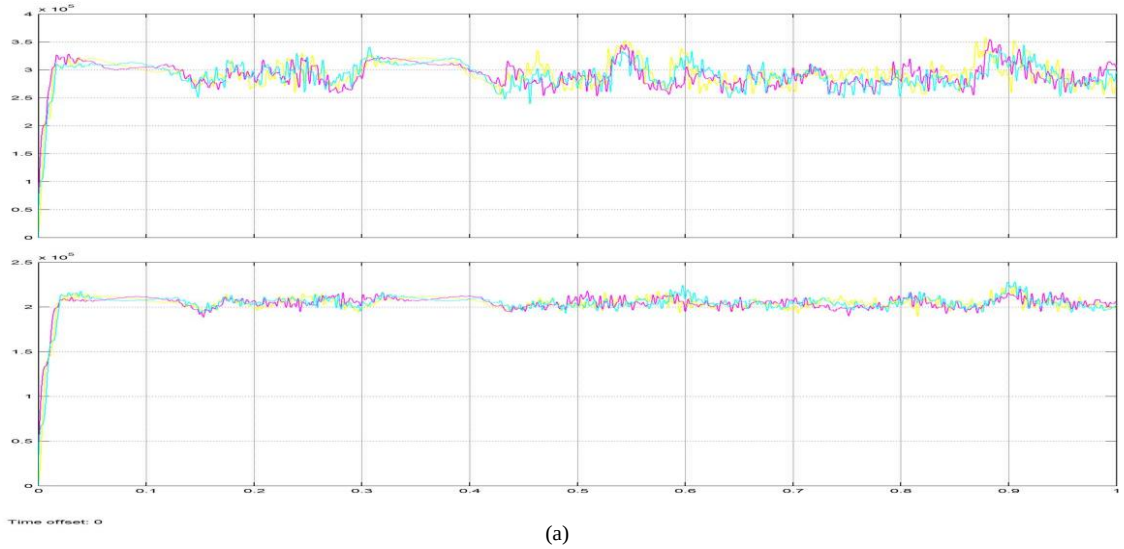
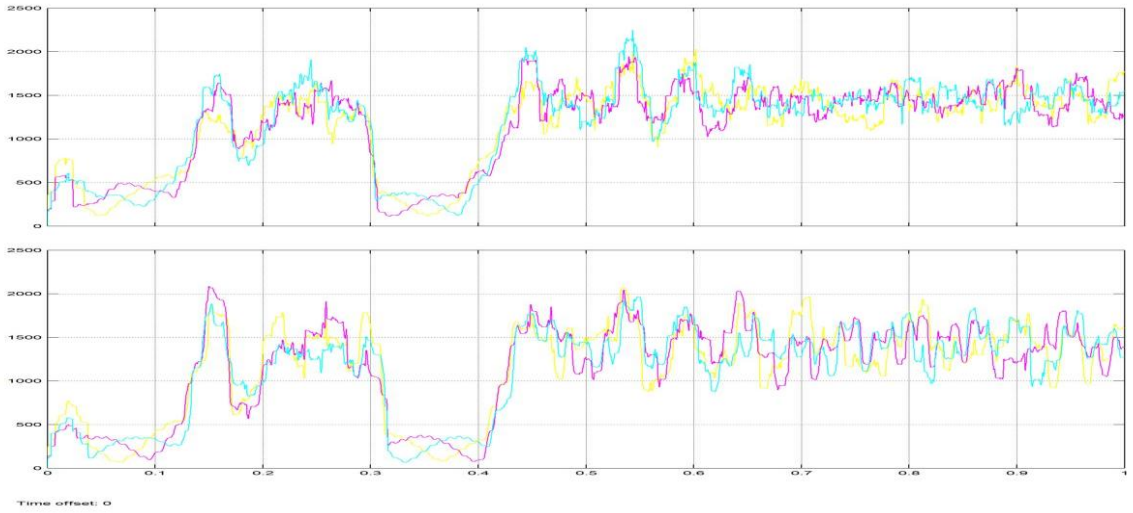
within the reactive power demand has inherent sluggishness, the system needs an extended time to recover.However by victimisation the coinciding ac-dc model the transient response is exaggerated and thence the transient stability.

The stability is extra exaggerated attributable to quicker current management mechanism of HVDC blocks that is the rectifier and convertor blocks. At intervals the management mechanism there is a master management and on a personal basis there is convertor and rectifier protection that works on VDCOL management procedures. Whenever the voltage dips on prevalence of a fault this can be restricted so the fault current is in addition diminished and additionally the foremost very important issue is that it's very little time constant that is it works in time.



(a)



(b)

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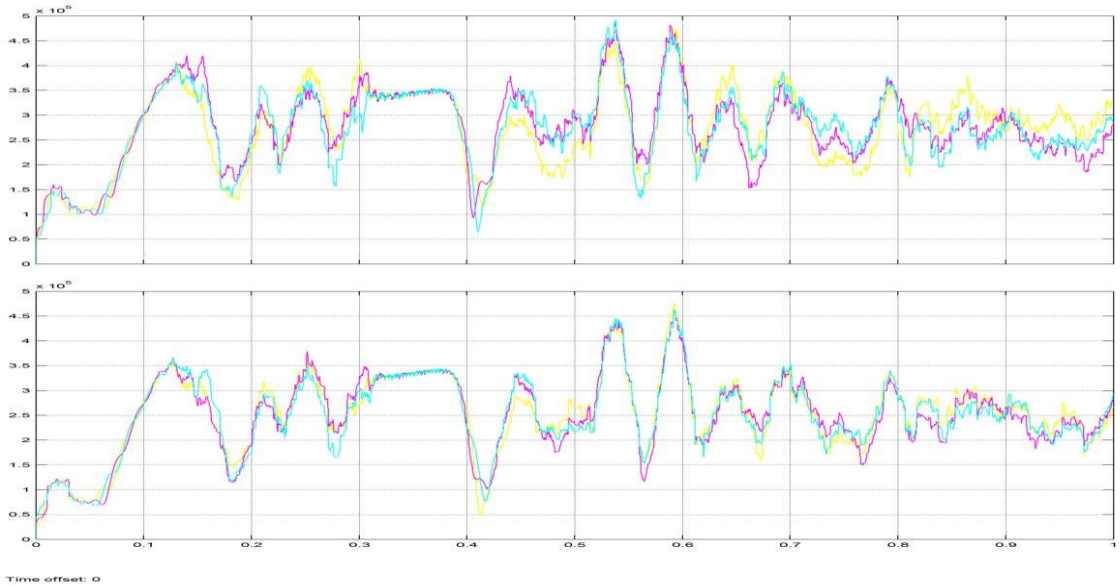

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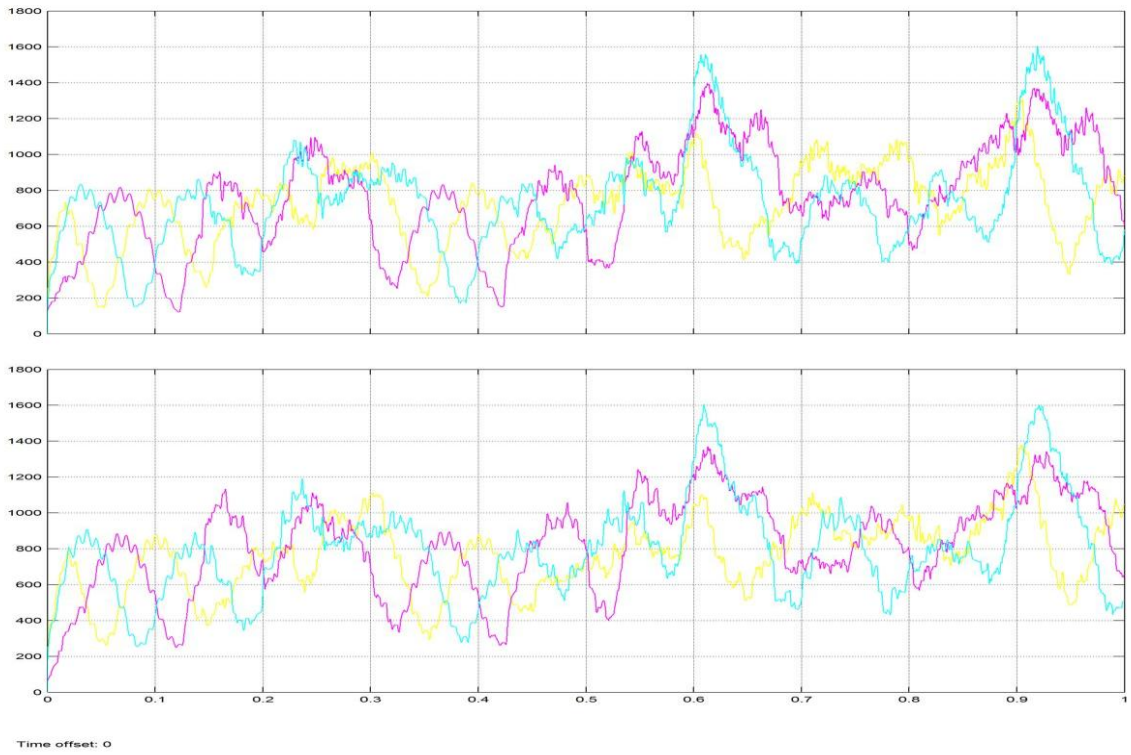

(d)

Fig.1. Power Profile (a) Sending & Receiving end Voltage Waveforms (b) Sending & Receiving end Current Waveforms (c) Sending & Receiving end Line Voltage Waveforms (d) Sending & Receiving end Line Current Waveforms

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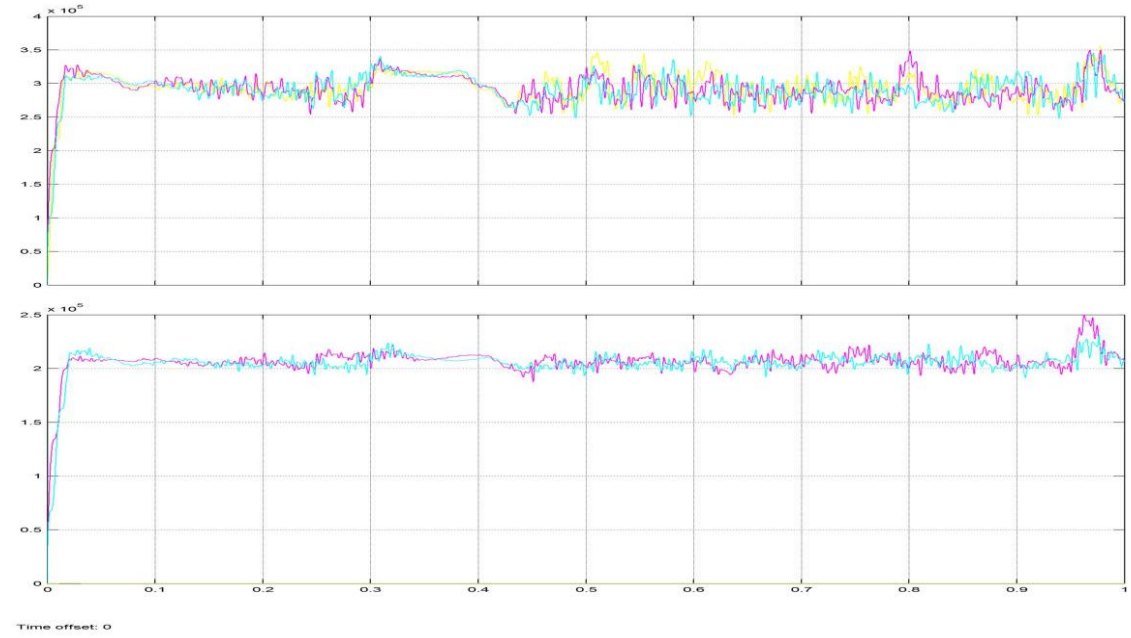
(a)



(b)

Fig. 2 Under Faulty Condition (a) Sending & Receiving End Voltage (b) Sending & Receiving End Current

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VI. RESULT & CONCLUSION

In this project, it's shown that by injecting DC power in AC power transmission lines, we are able to improve the transmission capability of the road by two to four times while not fixing the physical instrumentality. In each cable the faults occurred, that interrupts the supply, to avoid the faulty conditions some protection schemes are employed in cable. By considering such a disadvantage in cable and with employing a answer technique this work may be extended for analyzing the faults impact and completely different shield schemes appropriate to it particular form of transmission. As shown above in figure 1 the power profile of the sending and receiving ends under normal conditions. In figure 2 the faulty condition is illustrated how it affects the system and the power profile while the power transmission is a merged wave of both AC and DC power..

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