IJAREEIE

e-ISSN: 2278-8875

p-ISSN: 2320-3765

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 13, Issue 8, August 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.514

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

Analysis and Modeling for Enhancing Stability and Augmentation Power Transfer Capacity Utilizing STATCOM, SSSC and UPFC

S.Poomani, Mr.M.Sundaraperumal, Dr.J.Chandramohan

ME-PG Scholar, Department of Power Electronics and Drives, Gnanamani College of Technology, Namakkal, Tamil Nadu, India

Assistant Professor, Department of Electrical and Electronics Engineering, Gnanamani College of Technology Namakkal, Tamil Nadu, India

Associate Professor, Department of Electrical and Electronics Engineering, Gnanamani College of Technology Namakkal, Tamil Nadu, India

ABSTRACT: With the help of STATCOM, SSSC and UPFC, this research seeks to analyze and simulate system stability and augment power transfer capacity. To enhance stability and greater control over power transfer capabilities, the interconnected systems are outfitted with flexible AC transmission systems. A variety of modeling approaches can be used to illustrate how these devices function. FACTS devices that provide multi-variable control capabilities include the UPFC. To examine the effect of UPFC on load flow solutions, various load flow models have been examined. Two models are utilized to analyse the impact of UPFC in a linked system the power injection concept as well as the voltage source-based model.

KEYWORDS: Text detection, Inpainting, Morphological operations, Connected component labelling.

I. INTRODUCTION

Among the key components of the Flexible AC Transmission System family is the UPFC. It amalgamates static series with static synchronous compensator. These are controlled to offer simultaneous real-time and flexible series line compensation without the need for an external electric energy source [1]. It is attached by the common DC linkup, enabling two-way real power exchange between the series output terminals of the SSSC and the shunt output terminals of the STATCOM [2]. A series branch is made up the voltage source converters that connect a voltage through a transformer series with the application of a voltage that varies in phase angle and magnitude. UPFC's series branch can engage in real power interchange with the transmission line. It is necessary for the shunt branch to make up for any real power losses and power consumed or supplied by the series branch [3-5]. The capacitor cannot maintain a steady voltage if the power balance is not kept in check. A DC storage capacitor serves as the common DC link through which the two converters are powered. All of the power system's generators must maintain synchronism under both typical and unusual operating situations for the system to be stable [6-9].When significant disruption occurs in the power system, like a loss of generation, load, or transmission line, transient stability results. It is becoming an important consideration in daily operations and planning, and quick online solutions for transient stability are required in order to foresee any prospective loss of synchronization and take the appropriate action to bring the stability back. Many controller devices have recently been developed to reduce these oscillations and enhance system stability, which are present in contemporary power systems; nonetheless, conventional control and FACTS devices remain an alternative [10]. Controlling the synchronous machine's field currents is one of the excitation system's primary Goals. To control the machine's terminal voltage, the field current is regulated. Additionally, by regulating the generator rotor's excitation with the use of auxiliary stabilizing signals, power system stabilizer adds damping to the oscillations caused by the rotor. In order to offer damping, the stabilizer needs to generate an electrical torque component that is in sync with the rotational speed deviations [11-15].

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

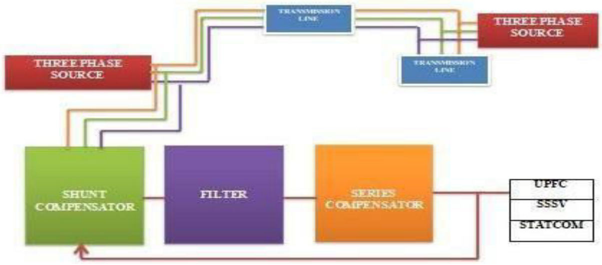

Fig. 1. Schematic Block

II. SSSC

The SSSC is a contemporary power quality factor correction device that utilizes a Convert voltage source linked connected to a transmission line via a transformer. Fig.2 describes the basic components of SSSC.Mainly it may be controlled independently and its injected voltage is not reliant on the line intensity. The SSSC can operate effectively under both high and moderate loads thanks to this characteristic. Similar to STATCOM a SSSC is connected serially rather than shunt. Its ability to supply the system with it maintains a high effective X/R independent of the extent of series compensation by using both reactive and active power compensating for resistive and reactive voltage decreases. But this is costly due to the requirement for a large amount of energy. In contrast, if control is limited to reactive compensation, a lower supply should suffice. Because the voltage vector in this instance forms a 90º angle with the line intensity, only the voltage is changeable.

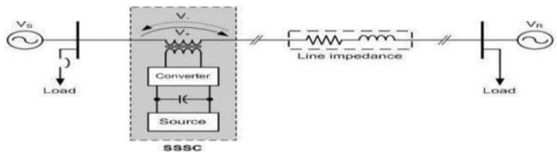

Fig.2.Basic components SSSC

For any given value, the injected voltage in series can advance or delay the Line current, allowing the SSSC to be consistently controlled. When SSSC is powered on and has the correct energy source, it can inject a voltage component that is equal in magnitude to the voltage created across the line but opposite in phase aspect. The voltage drop's impact on power transmission is therefore neutralized. Furthermore quick control and intrinsic neutrality against sub-synchronous resonance are features of the SSSC.

III. STATCOM

A power electronic device is called a Static Synchronous Compensator, or STATCOM that controls the flow of reactive power through a power network, hence improving network stability. It does this by utilizing force- commutative devices such as IGBT, GTO, etc. Since STATCOM is connected to the line in a shunt fashion, it is a shunt device. A Static Synchronous Compensator is sometimes called Static Synchronous Condenser. It is one of the gadgets in the FACTS STATCOM employs the term "synchronous," which refers to its capacity to either in order to stabilize the power network's voltage, create or absorb reactive power synchronously.

STATCOM DESIGN

A. A converter of intensity sources

A voltage-source converter is used to convert the DC input voltage into an AC output voltage.

B. DC Capacitor

Stable condition DC potential is supplied to the converter potential source, often known as VSC, by means of a DC capacitor.

C. Inductive Reaction

A transformer is linked to the Power System's and the VSCs output. Transformers serve as coupling media in essence. Moreover, the Transformer eliminates harmonics from the square waves that the VSC generates.

D. Harmonic Filter

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

Harmonic filter reduces the vibration-sustained harmonics and other high-frequency elements caused by the variable speed controller. Figure following shows a simplified schematic of the STATCOM together with its corresponding electrical circuit. Even though we've already covered the fundamentals of STATCOM operation, we will now comprehend how the system operates. The STATCOM's output voltage is represented by source Voltage1, as the above image makes evident. STATCOM raises its output voltage 1in response to an increase in the power system's reactive power demand while ensuring zero phase difference between Voltage 1and Voltage2, it‟s crucial to note that a slight phase angle between them persists due to the leakage impedance drop of the interconnecting transformer. Reactive power is transferred integrating a STATCOM into the electricity system when Voltage1 exceeds Voltage2, allowing the Static Synchronous Compensator to each of them generate and supply reactive power. Additionally, in the event of a load disturbance causing a rise in the power system's voltage, the STATCOM will decrease its output voltage Voltage1, thereby absorbing reactive power to restore the voltage to its normal level. This operational mode is termed Voltage Regulation Mode for the STATCOM .Nonetheless, Considering the distinct constraints of each equipment, the STATCOM must also comply with specific limitations on the quantity of reactive energy that it can produce or consume. Indeed, force-commutated devices like IGBT and GTO, among others, impose limitations due to their current carrying capacities. STATCOM operates at a consistent voltage and current, behaving as a constant current source. When operation nears a constraint, it supplies or absorbs reactive power up to its maximum limit. This mode of operation, termed VAR Control Mode in STATCOM, doesn't involve adjustments to its output voltage Voltage1.

IV. UPFC

A. POWER FLOW CONTROL FUNCTIONS OF UPFC

The generation is unable to fulfill the growing demand for power due to population growth and technological advancements. We can fulfill the demand if we make the most of the current generation, transmission and distribution infrastructure. Gadgets include a number of electrically powered devices. That has the ability to efficiently control every parameter related to the transmission line. The system's control parameters including voltage, phase angle, line impedance, etc., are all interconnected. Most transmission line control issues can be resolved with the right choice of FACTS controller. UPFC was made out of a DC storage capacitor connected in series with two regulated converters. An essential simulation technique for researching the convergence of FACTS devices and power system dynamics occurs primarily within load flow analysis. Current research focusing on UPFC load flow and dynamic models is receiving significant attention due to its potential to pinpoint the most suitable controller for converter utilization and evaluate the influence of UPFC on power system stability. This UPFC model known as the Power Injection Model makes it incredibly simple to include UPFC in load flow analyses. Fig.4 shows the power flow control of UPFC.UPFC which is shown as a network with two ports. This model known as the Model of Voltage Source for UPFC. This survey depicts shunt and series converters as in control potential sources and validate the contrast between the UPFC's PIM and VSM models for power flow management. This research examines the precise way in which these models describe UPFC.

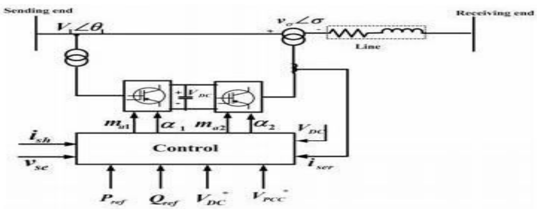

Fig.3.Control of UPFC

The selected modes of operation employ the automated mode for controlling power flow, incorporating automatic voltage regulation for both the shunt and series components. A series converter controls the complicated electrical need of the load or transmission line, whereas a shunt converter regulates the bus voltage and DC voltage at the shunt transformer's AC terminal. To maintain a proper operation of the two UPFC converters, the control blocks of the shunt and series Transformers depend on four reference inputs supplied by the UPFC: active power (Pref), reactive power, potential located at the shunt transformers couplings the point, as well as DC link voltage of the capacitor. Monitoring these set points is crucial.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

B. UPFC TRANSIENT STABILITY MODEL

Except for synchronous machine rotor circuits and particular controllers, the electrical network has traditionally been modeled using algebraic phasor equations to test transient stability. Indeed, during transient examinations, the UPFC's DC connection capacitor exchanges energy with the system, causing voltage swings. In this Fig.4 depicts the system's stable state. As a result, the criterion PE + PE = O is not applicable to transient stability assessments. The limits of the UPFC controls define how much the dc link voltage can vary. In transient stability studies, UPFC activity and their related Limitation is often expressed as difference equations that are not linear.

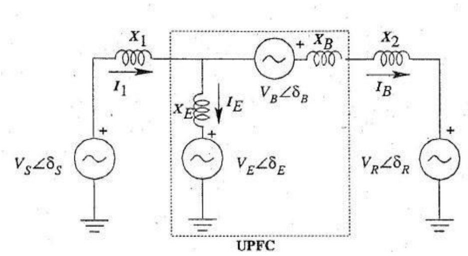

Fig.4.The diagram depicts the system's stable state.

C. APPLICATION EXAMPLES AND MODEL VERIFICATION

POWER INJECTION MODEL OF UPFC

Under various operating situations, The Power Injection Model UPFC is integrated into the standard IEEE 5-bus system allowing for successful operation. PIM and load flow analysis are simple to integrate. The coordination between converters is eliminated from the power injection paradigm. The buses that connect the UPFC have two power injections, a shunt and a series converter. A PV bus is commonly used to represent a series converter, whereas a PQ bus is used to represent a shunt converter. Where γ is angle injected voltage and r is proportion to Vs that is injected into the line. where Isr is the line current and b is the reciprocal of reactance. The integration of shunt side power injection and series side power injection results in the creation of the Power Injection Model (PIM) for the UPFC. During the model's construction, it was assumed that the series converter regulates Qsh independently, or it might be assumed that Qsh=0, in which case active power loss between the buses is not considered.

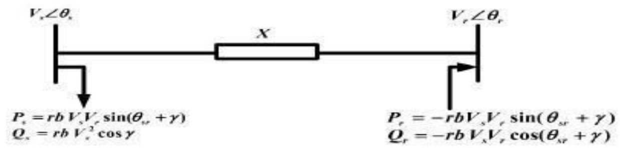

Fig.5 PIM of UPFC.

D. EXAMINING LOAD FLOW USING THE UPFC ENERGY INJECTION CONCEPT

With bus 5 experiencing higher load conditions Following load flow study of IEEE 5 bus structure .it has been established that buses 2 and 5 will encounter inadequate voltage stability during steady-state load conditions.Fig.6 describe the load flow of UPFC. Thus, the route that links buses 2 and 5 is where UPFC is located. Bus 4 and Bus 5 voltages decrease as the demand on the bus 5 increases as 0.5 + j0.25 pu into 0.89 + j0.44 pu, the potential at buses 2 and 5 minimizes from 0.97 pu to 0.92 pu and 0.94 pu, respectively. For investigating the impact of an UPFC on active electrical flows a UPFC PIM connected between buses 4 and 5 can be used The flow of electricity has advanced significantly, according to the system's flow of load assessment via every bus's unique line and voltage profiles. Power flows for an The image depicts the IEEE 5-the bus systems with a UPFC at r= 0.1 and γ = 50°.value of r has a significant impact on the reactive power produced or consumed at UPFC AC terminals. When the load on Bus 5 reaches 0.89+j 0.447 pu, the value of γ indicates the power transaction that is now taking place between the line and the UPFC. According to the load flow research, if r is raised above the Maximum proportion of the injected voltage, or rmax = 0.2 pu, all of the buses will become unstable.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

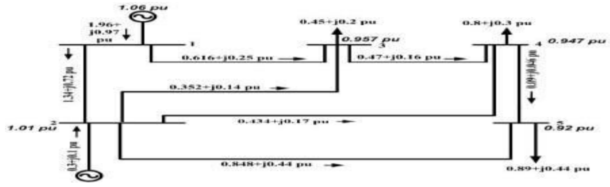

Fig.6.Diagram of UPFC's Load Flow

E. UPFC'S SUPPLY MODEL

Shunt and series voltage are seen by the UPFC VSM as controlled voltage sources according to the correct phase angle and magnitude. The PI controller keeps track of the set points for voltage and power. The control method was Created with the presumption that the characteristics of shunt and series converters are naturally separated. The series and shunt transformer parameters are taken into account when Creating the Virtual Synchronous Machine (VSM). The source end, which includes a shunt component and internal impedances r and x, is connected to Bus 1.A series injection transformer is used to perform the series voltage injection. Indeed the voltage at bus 2 is obtained by adding the phase of the voltage at bus 1 and the series injected voltage. Fig.7 shows the single line dynamic model of UPFC.

References to active power (P3) and reactive power (Q3) are established at Bus 3, which corresponds to the UPFC's series converter end. The Virtual Synchronous Machine (VSM) also takes into account voltage drops in transmission line parameters R and X.

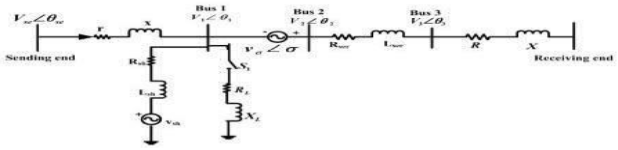

Fig.7.The UPFC dynamic model is shown by a single line schematic.

F. MODELING OF A SHUNT CONVERTER

Shunt converters are frequently depicted as having a customizable voltage source and passive shunt transformers characteristics in series with it. A shunt converter at the line's connection point either supplies or absorbs reactive power as current passes through it. The reactive and active components, q* and Ip*, can be separated out of the ish. The PI controller, which tracks VPCC*, provides the first component. By tracking VDC*, the second one is likewise obtained via a PI controller. Assuming that the series portion of the UPFC is not operating at that particular time, The decoupling equation regulating shunt converter operation has been written down.Fig.8 describe the locks of shunt converter.

G. SERIES CONVERTER CONTROL

When comparing the measured values of Pref and Qref, a controller that tracks these values is needed for the UPFC power flow control mode. When modeling a series converter, it is assumed that power system variations have no effect on it, but shunt converters do. For modeling purposes every bus voltage is broken down into d-q components. Here are the voltage formulae for the injected voltage into the vdser and vqser decoupling voltage at various buses: bus 1's v1d and v1q, bus 2's v2q and v2d, and bus 3's v3d and v3q. By using the values of v2d, v2q, idser, iqser we can calculate P3, Q3.Fig.8 express the schematic block diagram of the series converter.

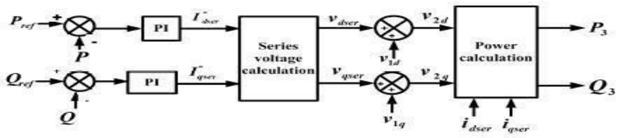

Fig.8.A block schematic of the Series Controller

H. MODELING THE CAPACITY OF A DC LINK

In the design of UPFC's, the dynamic settings of the DC link capacitance are essential. This can be accomplished by equal the energy variation on either side of the capacitor during the transient period. The distinction between the Pseries and Pshunt is the real power computation at imaginary bus 2.The real power changes in UPFC are directly correlated with the capacitor voltage VDC. The formula below calculates a variation in the capacitor voltage during fluctuations,

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

where gc and bc denote the conductance and susceptibility of the DC link capacitors" dynamics mode.

I. VOLTAGE STABILITY IMPROVEMENT USING UPFC

- MONITORING OF THE SHUTDOWN SWITCH

From the system, the Converter for shunts extracts a regulated current. Fig.9 describes the Adjustment for the shunt converters. One of the halves of this current Ip, is automatically computed to maintain equilibrium with the real power sent across the DC link to the series converter. By using feedback control to adjust the DC capacitor voltage, this power balance is maintained. The other aspect of the shunt translator current, reactive current, is controllable comparable to a STATCOM.

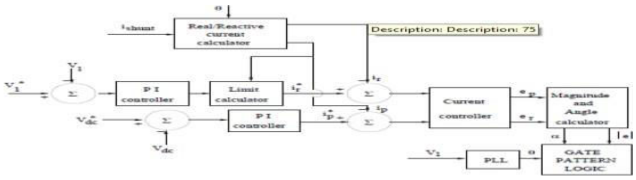

Fig.9.Adjustment for the shunt converters

- MAINTENANCE OF A SERIES OF THE CONVERTER

In order to maintain the desired current flow (phasor) even in the event of system disruptions, a vector control system determines the series injected voltage in this control mode. In Fig.10 express the control of the series converter . Serial controller the complex power flow in the line must be regulated under normal circumstances, but under emergency situations, the controller must also dampen power oscillations to contribute to system stability.

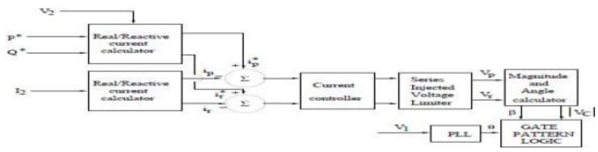

Fig.10.Control of the series converter

V. RESULTS AND DISCUSSION

In this section the discussion about the results of UPFC, STATCOM and SSSC. Here there are number of results shown in figures.

1. UPFC

In UPFC system the real and reactive power flow can be controlled. It enhances the power capacity, transients disturbance has been limited in this system.

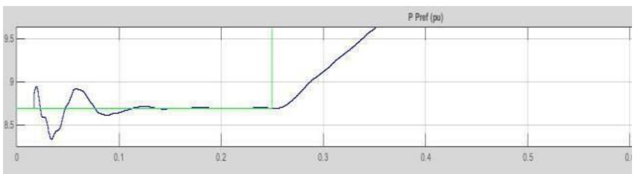

Fig.11 Simulation output of UPFC Pref

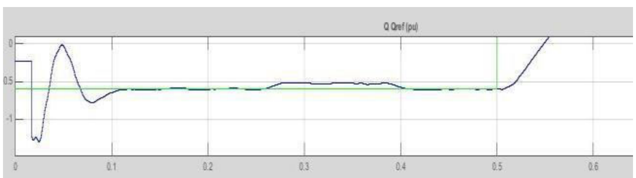

Fig.12. Simulation output diagram of UPFC Qref

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

The Fig.1,2 shows the reference power flow of real and reactive power of upfc .Here the reference power of upfc is increased .

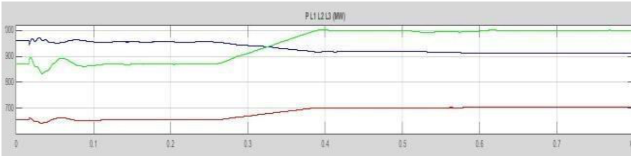

Fig.13. Simulation output of UPFC P L1 L2 L3

The diagram 3 depicts the three phase line real power flow. In this result the three phase real line power is maintain stable power flow condition

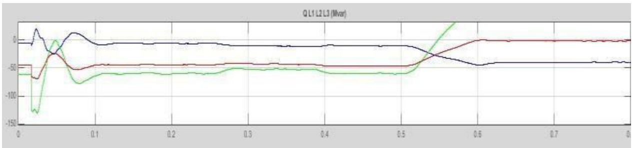

Fig.14. Simulation output of UPFC Q L1 L2 L3

In Fig.4 Describes the three phase reactive line power flow of upfc system.

2. STATCOM

The result of STATCOM system, the real and reactive power can able to increase the maximum power transfer capability of the network.Fig.5 waveform shows the reference reactive power flow of STATCOM.

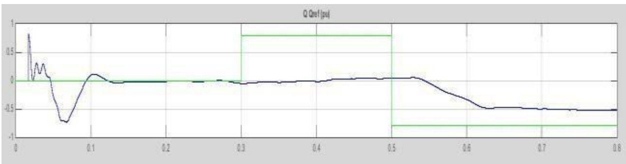

Fig.15. Simulation output of STATCOM Qref

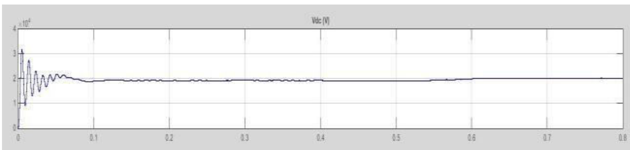

Fig.16 Simulation output of STATCOM Vdc

The Fig.6 shows the direct current voltage of STATCOM. Here the waveform clearly shows the result of Vdc.

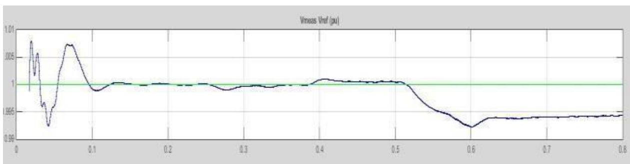

Fig.17. Simulation output of STATCOM Vmeas Vref

In Fig.7 describes the measure voltage and reference voltage of STATCOM.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

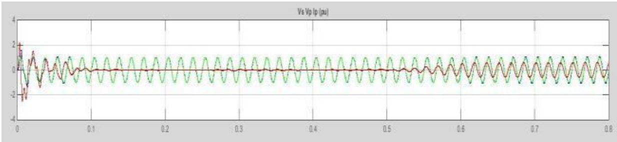

Fig.18. Simulation output of STATCOM Vs Vp Ip

Fig.8 depicts the primary voltage, secondary voltage and primary current of STATCOM. Here this sinusoidal waveform is clearly shows the result of Vs, Vp and Ip.

3. SSSC

The result of SSSC is control the power flow .The following result shows the real and reactive power flow control of SSSC.Fig.9 shows the injected voltage waveform of SSSC.

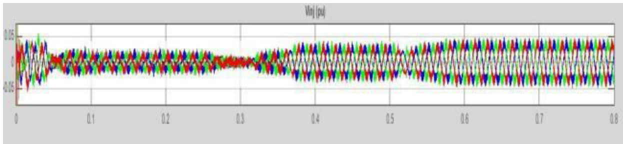

Fig..19. Simulation output diagram of SSSC Vinj

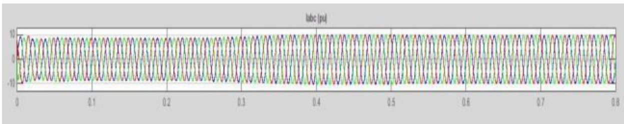

Fig.20. Simulation output of SSSC Iabc

Fig.10 Describe the three phase current of SSSC. Here the waveform clearly shows the result of Iabc.

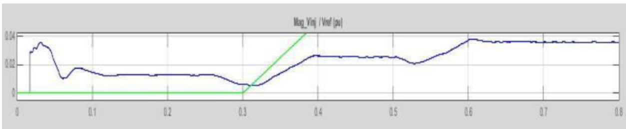

Fig.21. Simulation output of SSSC Vref

Fig.11 depicts the reference voltage of SSSC. Here this waveform is clearly shows the result of Vref.

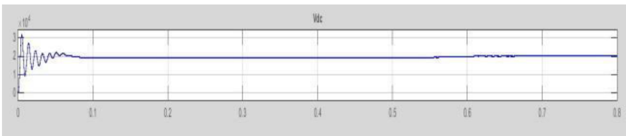

Fig.22. Simulation output of SSSC Vdc

The Fig.12 shows the direct current voltage of SSSC. Here the waveform shows the stable flow of voltage.

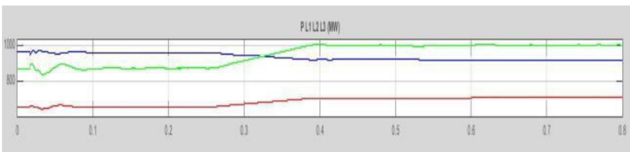

Fig.23. Simulation output of SSSC P L1 L2 L3

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

In this Fig.13 describe the three phase line power flow L1,L2 and L3.

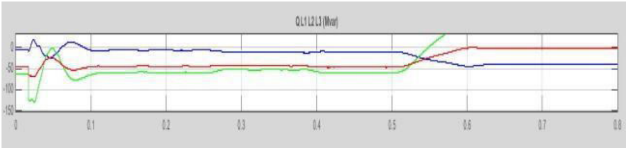

Fig.24. Simulation output of SSSC Q L1 L2 L3

The Fig.14 depicts the three phase reactive line power L1,L2 and |L3.Here the three reactive line power are clearly identified by using this result .

VI. CONCLUSION

UPFC, FACTS device are capable of regulating voltage, compensating reactive power, and putting voltage in phase angle to meet the requirements of the power system. When evaluating the performance of UPFC in a networked system, the IEEE norm for the 5-bus system is frequently utilized as a benchmark. One tool to see the system's performance in a steady state is a load flow study. In this scenario optimal placement of Unified power flow controller is found on transmission lines 2–5 in a system with five buses. Utilizing Unified power flow controller controllers integrated into the modelling, the Voltage Source Model for the Unified Power Flow Controller is designed to fulfil the unique needs of the power system. The Virtual Synchronous Machine (VSM) contained in the UPFC monitors the voltage at the transmitting end and the line current inside the power system, generating a reference voltage customized to specific load situations. When there is a disparity between the reference voltage and the real load voltages, adjustments made to line to mitigate a discrepancy. As a result, the voltage profile at each bus is enhanced, and the electricity flow via the line, both reactive and active, is modified. With an interconnected system, the load flow solution makes it simple to determine the impact of UPFC. By installing UPFC in one of the transmission lines, voltage stability and improved power flow are ensured. As a result of this model taking into account all of the parameters and losses of the UPFC, When compared to the Power Injection Model (PIM),a load flow estimation of the Virtual Synchronous Machines (VSM) of UPFC often yields somewhat lower voltage improvement and power flows. However, it's important to note that the PIM only calculates the power injection of the series and shunt converters without considering the detailed dynamics of the system. One of VSM of UPFC's most notable benefits is that it additionally considers the dynamics related to the DC link capacitor.

REFERENCES

[1] S. Parvathy, “Analysis and modeling of UPFC : A comparison between power injection model and voltage source model,” IEEE Tensymp 2017

[2] Geethu, K.C Sindhu Thampatty, “Design And Implementation Of Series Connected FACTS Devices For Enhancing Powersystem Oscillation Damping,” IJAIET, vol. 3, no.6, pp. 13–20,2016.

[3] Ambriz-Perez H, Acha E, Fuerte-Esquivel CR, De la Torre A, “Incorporation of a UPFC model in an optimal power flow using Newton‟s method”, IEE Proceedings- Generation, Transmission and Distribution 1998;145:336.

[4] Nabavi-Niaki M.R. lravani, “Steady-state and dynamic models of unified power flow controller (upfc) for power system studies”, IEEE Transactions on Power Systems, Vol.11, No.4, November 1996.

[5] S. Parvathy and K. C. Sindhu Thampatty, Science Direct, “Dynamic Modeling and Control of UPFC for Power Flow Control,” Procedia Technology 21, pp.581 – 588, 2015.

[6] G. V Marutheswar and R. V. S.Satyanarayana, “Control Setting Of Unified Power Flown Controller through load flow calculation,” ARPN, vol. 3, no. 6, pp. 6–10, 2008.

[7] Sanbao Zheng And Yoke Lin Tan “ Dynamic Character Study of UPFC Based on Detailed Simulation Model”,IEEE Power Conference 2000.

[8] Padiyar, K.R., Kulakarni, A.M, “Control Design And Simulation Of Unified Power Flow Controller,” IEEE Tans. on Power Delivery, Vol.13, No.4, October 1998,pp.1348-1354.30

[9] I.Papic, P.Zunko, D.Povh, M.Weinhold, “Basic Control Of Unified Power Flow Controller,”IEEE Transactions On Power Systems, Vol.12, No.4.November 1997.

[10] C.D schauder, L.Gyugyi, D.M Hamai “Operation of the unified power flow controller under practical constraints, ” IEEE transactions on power delivery Vol.13,No.2,April 1998.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.514|| A Monthly Peer Reviewed & Referred Journal |

||Volume 13, Issue 8, August 2024||

|DOI:10.15662/IJAREEIE.2024.1308011|

[11] L.Gyugyi, C.D. Schauder, S.L. Williams, T.R.Rietman, D.R.Torgerson, A.Edri,"The Unified Power Flow Controller: A New Approach to Power Transmission Control,"IEEEn Transaction Power Delivery; Vol.10, No.2 April 1995,pp.1085- 10.

[12] Kannan Sreenivasachar, „Unified power flow controller: Modeling, Stability analysis, Control strategy and Control system Design" PhD Thesis, Electrical and Computer Engineering, University of Waterloo, Ontario, Canada, 2001.

[13] Y. H. Song and A. T. Johns, "Flexible AC Transmission System (FACTS)", IEE Power and Energy Series 30, 1999.

[14] E.V.Larsen, J.J.Sanchez-Gasca and J.H.Chow"Concept for design of FACTS controllers to damp power swings", IEEE TPWRS, Vol.10, 1995.

[15] NareshAcharya, ArthitSode-Yome, NadarajahMithulananthan"Facts about Flexible AC Transmission Systems (FACTS) Controllers" Practical Installations and Benefits" ,IEEE power and energy series 20, 1997.