JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 06, ISSUE 07, 2019

Analysis and implementation of FACTS devices on a transmission line

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Abstract : Due to the dynamic nature of the electric power system and the significant increase in non-linear loads, excellent power quality is a significant challenge. To enhance its performance, it is thus necessary to limit these disruptions and minimize. The power quality results are directed. In the 22 kV examination, a three stage, three wire transmission framework was connected to the MATLAB climate utilizing the UPFC's phasor model. This study examines the exhibition and control of UPFC that will be introduced on a transmission line. Results from recreations exhibit how well UPFC controls genuine and receptive power moving through the line.to the dynamic nature of the electric power system and the significant increase in non-linear loads, excellent power quality is a significant challenge. To enhance its performance, it is thus necessary to limit these disruptions and minimize three wire transmission frameworks connected to the MATLAB climate utilizing the UPFC's phasor model. This study examines the exhibition and control of UPFC that will be introduced on a transmission line.

Keywords : Power Quality, Harmonic, UPFC,

1. Introduction

All over the planet, the development of power structure utilities has advanced quickly, with enormous mechanical degrees of progress and movements in the arrangement and action transmission, and flow structures is normal in light of the consistent mechanical movements. Purchasers of energy at all levels of use put a creating proportion of importance on the issue of power quality. Both the cutting edge and home circumstances as frequently as conceivable contain, which has incited a creating stress over, huge motor starting, introduced age, fragile stuff, storms, and various factors are the essential drivers of issues that could impact the idea of the power environmental naughtiness, network hardware, and plan. Exactly when creation processes become more confounded and demand a higher obligation level, which integrates targets like giving energy without impedance, without consonant winding, and with strain rule between uncommonly flimsy edges [1].

To sustain the dependability of the power structure, the majority of the in emerging nations with colossal, associated making saves. Regardless, as enormous associated networks ended up being more tangled, the consistency of the power supply changed, provoking system dubiousness, inconvenience controlling the power stream, and security gives that provoked different blackouts in various locale of the world. The recently referenced weakness progressions could have happened owing to orchestrate over-trouble, lacking power system affiliations, nonattendance of upkeep, or central issues in orchestrating and movement. Foundation of new transmission lines is critical to avoid these effects, supply the right power stream, and assurance the relentlessness and consistency of the structure. Anyway, the colossal, associated power system confines the foundation of additional transmission lines on account of things like money related cost and ecological worries. The difficulty of adding additional transmission lines to a power structure powers power experts to investigate procedures for extending power stream through an ongoing transmission line without compromising the dauntlessness and security of the system [2].

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There Four classes of Realities regulators might be distinguished:

1. Controllers for a series.

2. Shunt control devices.

3. Controllers with combined series-series.

4. Controllers that combine series and shunt.

1.1 Series Controllers

MATLAB climate utilizing the UPFC's phasor model. This study examines the exhibition and control of UPFC that will be introduced on a transmission line. Results from recreations exhibit how well UPFC [3].

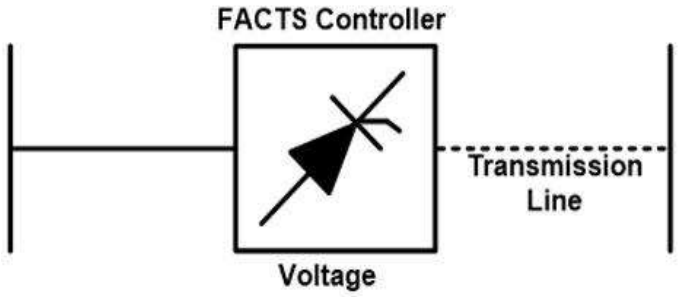

Figure 1 Static Synchronous Series Compensator (SSSC)

1.2 Shunt Controllers

The power quality results are directed. In the 22 kV examination, a three stage, three wire transmission framework was connected to the MATLAB climate utilizing the UPFC's phasor model. This study examines the exhibition and control of UPFC that will be introduced on a transmission line. Results from recreations exhibit how well UPFC controls genuine and receptive power moving through the line.

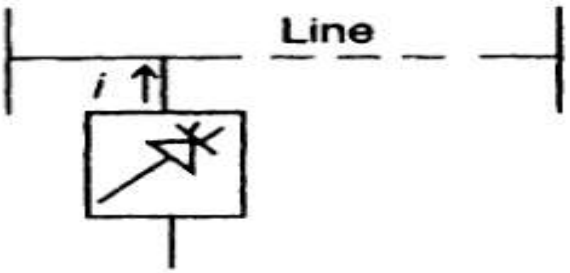

Figure 2 Static Synchronous Compensator (STATCOM) is one such controller.

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1.3 Combined Series-Series Controllers

In a multilane gearbox framework, this may be a blend of a few series regulators that are worked in show. Or on the other hand it very well might be a bound together regulator, in which series regulators communicate genuine power across the lines through the power association while likewise giving free series receptive remuneration to each line [4].

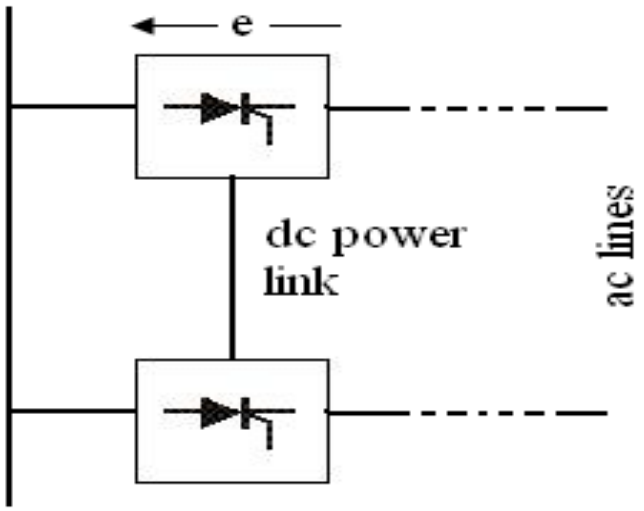

Figure 3 Interline Power Flow Controller comes in this category

1.4 Combined Series-Shunt Controllers

It may a blend of discrete, helpfully controlled regulators or a consolidated power stream regulator having shunt and series parts. Blend shunt and series regulators, which put the voltage from the shunt piece of the regulator in series with the series part of the regulator, hypothetically infuse current into the framework. The series and shunt regulators, in any case, can truly trade power by means of the power association when the shunt and series regulators are joined [5].

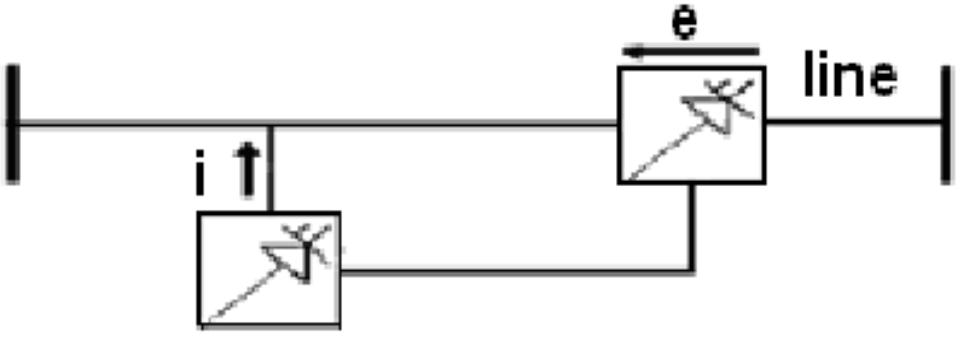

Figure 4 Interline Power Flow Controller comes in this category

2. POWER QUALITY

Type A instruments as outlined in IEC 61000-4-30 must be used to test power quality. This guarantees that the measurement findings meet pertinent requirements and are permissible for usage without limitations. The current flow of the linked loads should also be taken into consideration when assessing power quality. It is essential to measure both the voltage and the currents. Whatever the measuring technology, it must be able to measure voltages and currents at appropriately high

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Power Quality is the ability of the power grid to supply power to the consumers more efficiently and it also expresses the ability of an equipment to consume the power supplied to it [6].

2.1 Causes of Poor Power Quality

Frequency and magnitude variations in voltage can be caused by a rapid increase or decrease in demand, power outages, inverters, power electronics converters, etc.

2.2 Measuring Power Quality

Type A instruments as outlined in IEC 61000-4-30 must be used to test power quality. This guarantees that the measurement findings meet pertinent requirements and are permissible for usage without limitations. The current flow of the linked loads should also be taken into consideration when assessing power quality. It is essential to measure both the voltage and the currents. Whatever the measuring technology, it must be able to measure voltages and currents at appropriately high frequencies in order to allow for the examination of measurement data for compliance with standards. The recorded harmonics should be evaluated over a 10-minute timeframe. A common feature of contemporary measurement devices is the ability to map extra intervals. In many instances, it is vital to look at the 10-minute mean data to see whether there are any electrical network events that are quite active. Because of this, measurement devices only produce maximum values for 10 or 200 ms intervals, depending on the device quality, which should be assessed in relation to how they affect power quality.

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Figure 5 Power Quality Measuring Instrument (Network Stabilizer)

2.3 To Improve the Power Quality

Using Compensation Technique

Using Passive Technique

Using Active Technique

3. UNIFIED POWER FLOW CONTROLLER (UPFC)

UPFC is a combination of STATCOM and SSSC coupled via a common DC voltage link.

3.1 Principle of Operation

The principle of operation of a Unified Power Flow Controller (UPFC) involves controlling and regulating power flow in an electrical transmission system. UPFC is a flexible AC transmission system (FACTS) device that utilizes power electronics to enhance the performance and efficiency of power transmission.

The key components of a UPFC include:

Series Voltage Regulator (SVC): This part is associated in series with the transmission line and controls the voltage size and stage point. By infusing a voltage in series with the line, it can successfully direct the power stream.

Shunt Voltage Regulator (SVC): This part is associated in lined up with the transmission line and controls the voltage size. It can ingest or infuse responsive ability to balance out the framework voltage.

Phase Moving Transformer (PST): This part is answerable for changing the stage point between the sending and getting closures of the transmission line. By controlling the stage shift, it empowers the ideal power stream.

The activity of an UPFC includes ongoing observing of framework conditions and nonstop change of the infused voltages and stage movements to accomplish the ideal power stream control. By progressively controlling the series and shunt parts, the UPFC can relieve transmission line clog, further develop voltage strength, and upgrade the general framework execution.

In outline, the guideline of activity of an UPFC spins around the organized control of series and shunt voltage regulators, alongside a stage moving transformer, to direct power stream and work on the solidness and productivity of the electrical transmission framework.

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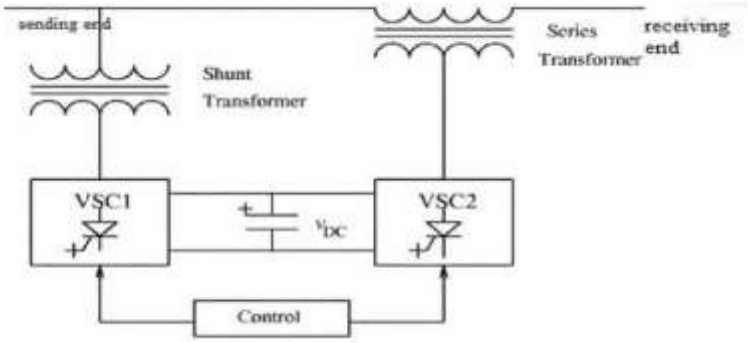

Figure 6 Circuit Diagram Of UPFC

3.2 Unified Power Flow Controller (UPFC) Detailed Model

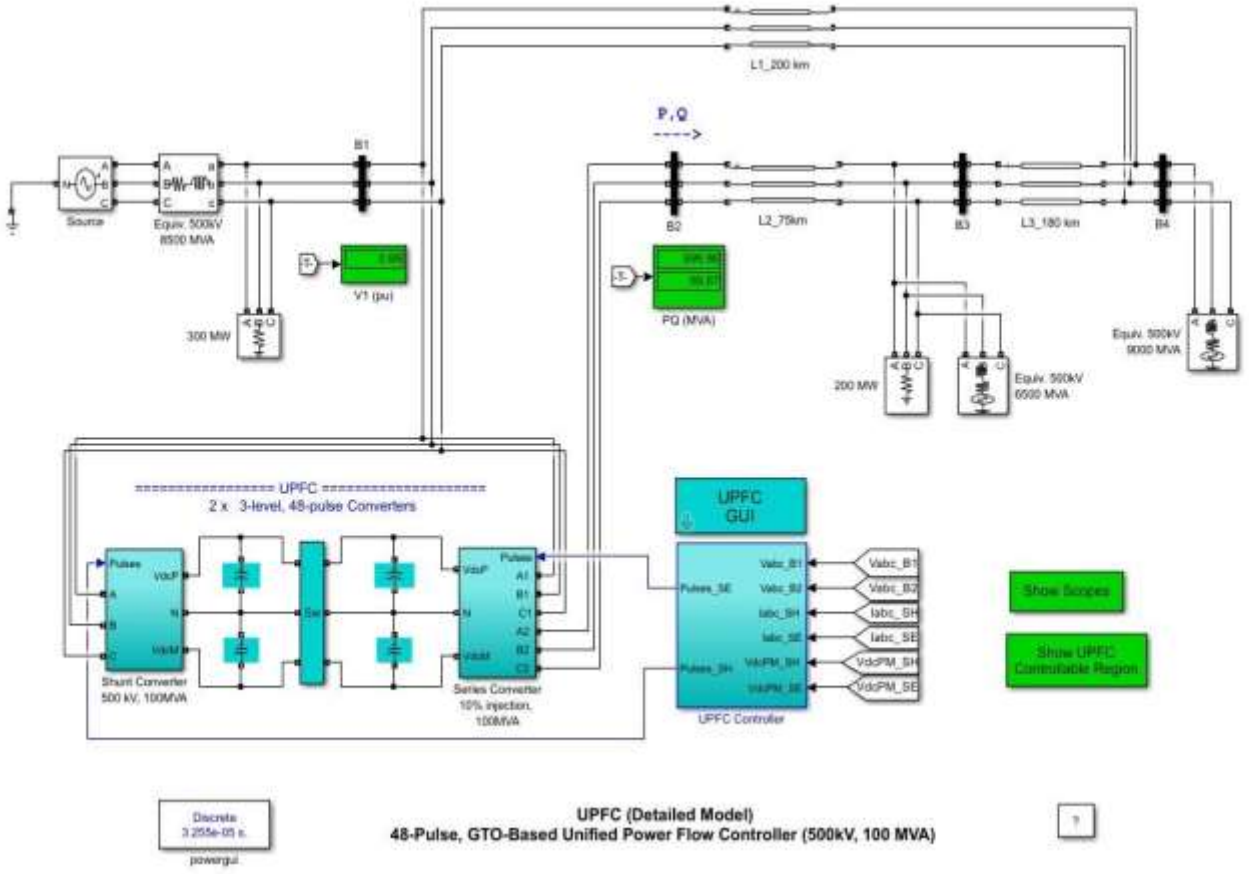

Figure 7 Detailed Model of UPFC

3.3 Modelling of UPFC

The power quality results are directed. In the 22 kV examination, a three stage, three wire transmission framework was connected to the MATLAB climate utilizing the UPFC's phasor model. This study examines the exhibition and control of UPFC that will be introduced on a transmission line. Results from recreations exhibit how well UPFC controls genuine and receptive power moving through the line.

3.4 Description of Single Line Diagram

The power stream in a 2.2KV/66KV gearbox system is managed by an UPFC. The system is set up as

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a circle, with two 2.2 kV/66 kV transformer banks, Tr1 and Tr2, and five vehicles (B1 to B6) that are related by three transmission lines (L1, L2, and L3). 17.2 MW, which is the combined consequence of two power plants on the 2.2 kV system (showed in figure 2), is shipped off a 66 kV, where it is used to supply a 23 MW load associated with transport B5 at Sathegala. To look good, a chance circumstance is contemplated in which Transformer T2 trips as a result of error or for fix, eliminating ability to the sathegala load. This issue can be settled by including UPFC in the system.

Between transport 3 and transport 4, there is an UPFC that will give power stream rule in the line. The UPFC power (shunt and series) converter is used connected with generator 1's power yield. The 15MW furthest reaches of UPFC converters is set up in a way meet the pile. The series converter will add voltage in expansions of 0.1 pu, further developing the voltage profile of the structure, and supply the power system with the significant certifiable and open power.

3.5 Explanation of Simulink Model

Figure 3 illustrates the single-line diagram created by the matlab simulink tool to mimic the transmission network seen in figure 2. The model's crucial inputs are

A. UPFC prevent connection or disconnection from the system using the bypass breaker.

B. Sinks that supply the waveform for UPFC modelling.

C. The inputs for reference power [P Qref] - Reference for controlling power flow

D. Reference for voltage injection: The reference voltage Vdref

3.6 Simulation Results

By picking outer control of the detour breaker, UPFC is added to the framework. The breaker is actuated at regular intervals, permitting the UPFC block to be added to the transmission organization. The reason or capability of UPFC begins at T=5sec, causing an infusion of voltage and power. Figure 1 shows the fundamental reenactment result waveform both with and without the UPFC.

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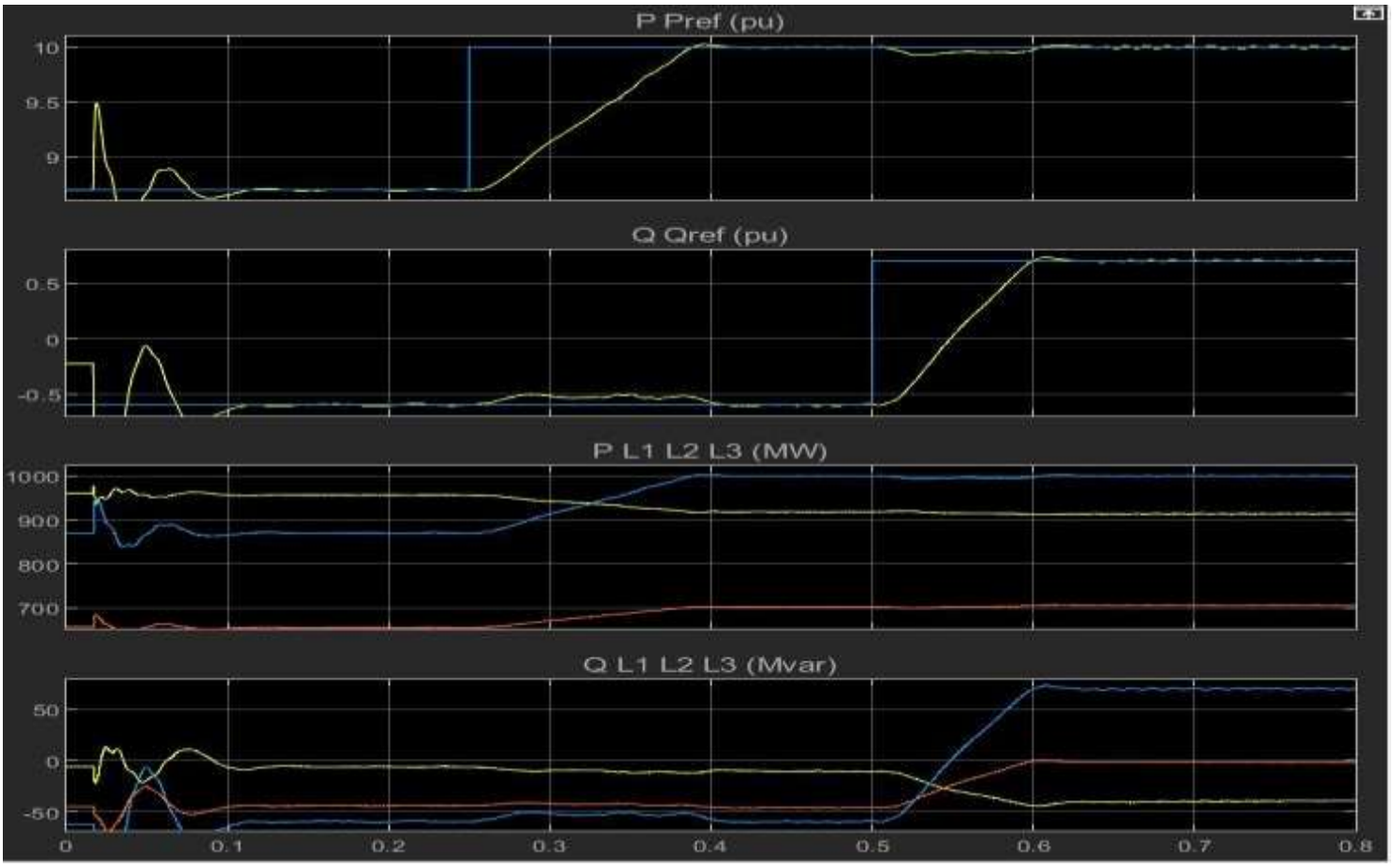

Figure 8 Unified Power Flow Controller output

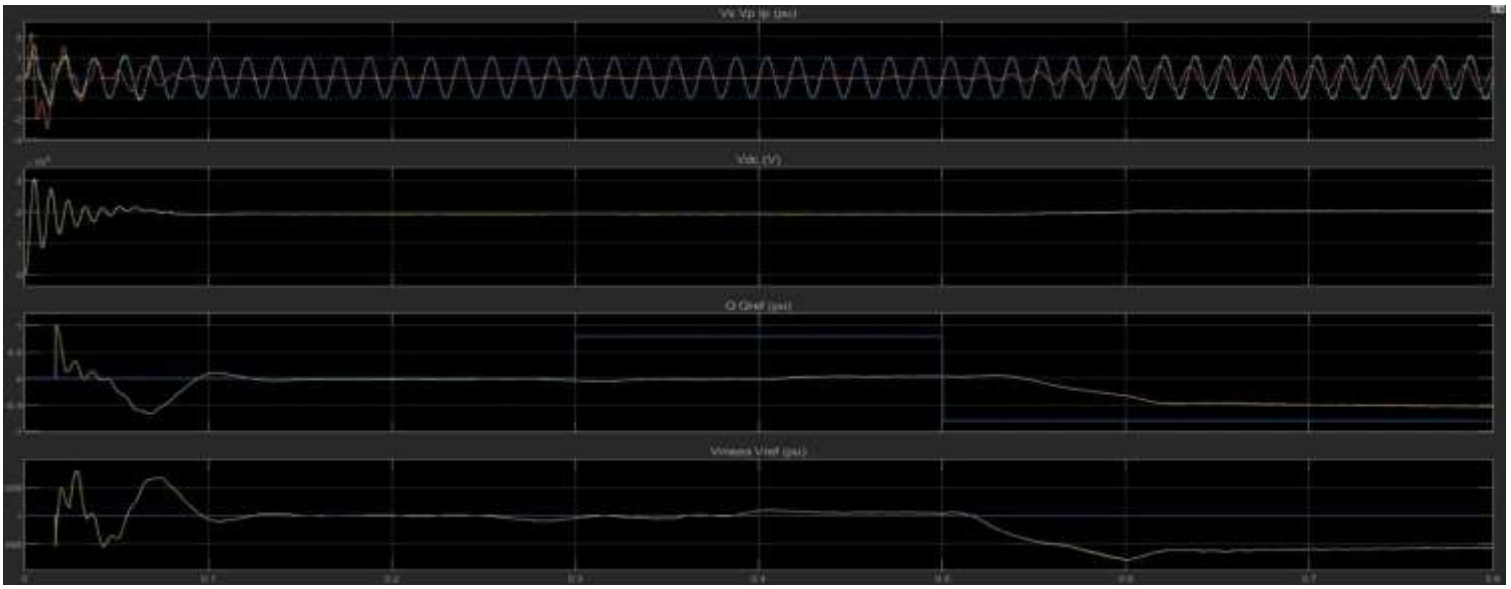

Figure 9 Static Synchronous series compensator (STATCOM

3.7 P-Q characteristics

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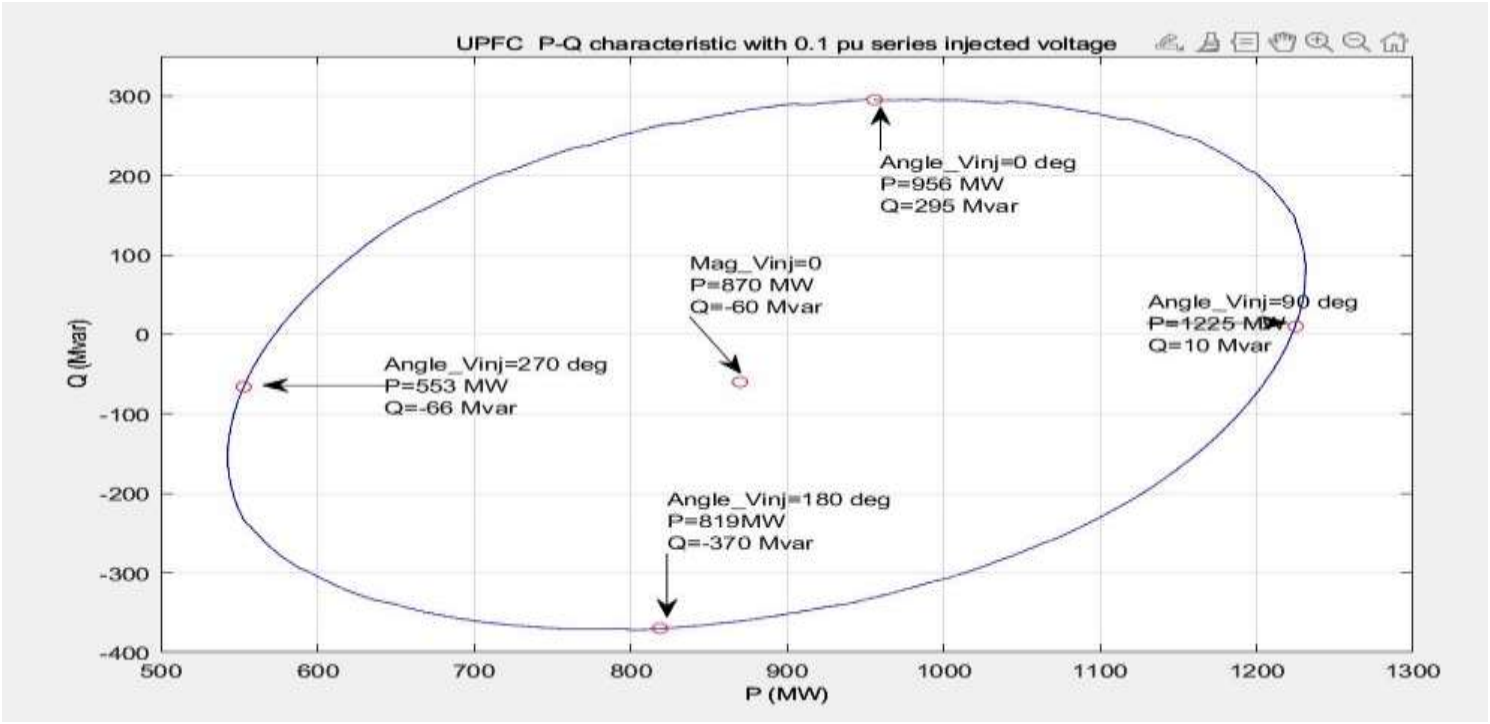

Figure 10 P-Q Characteristics of Unified Power Flow Controller(UPFC)

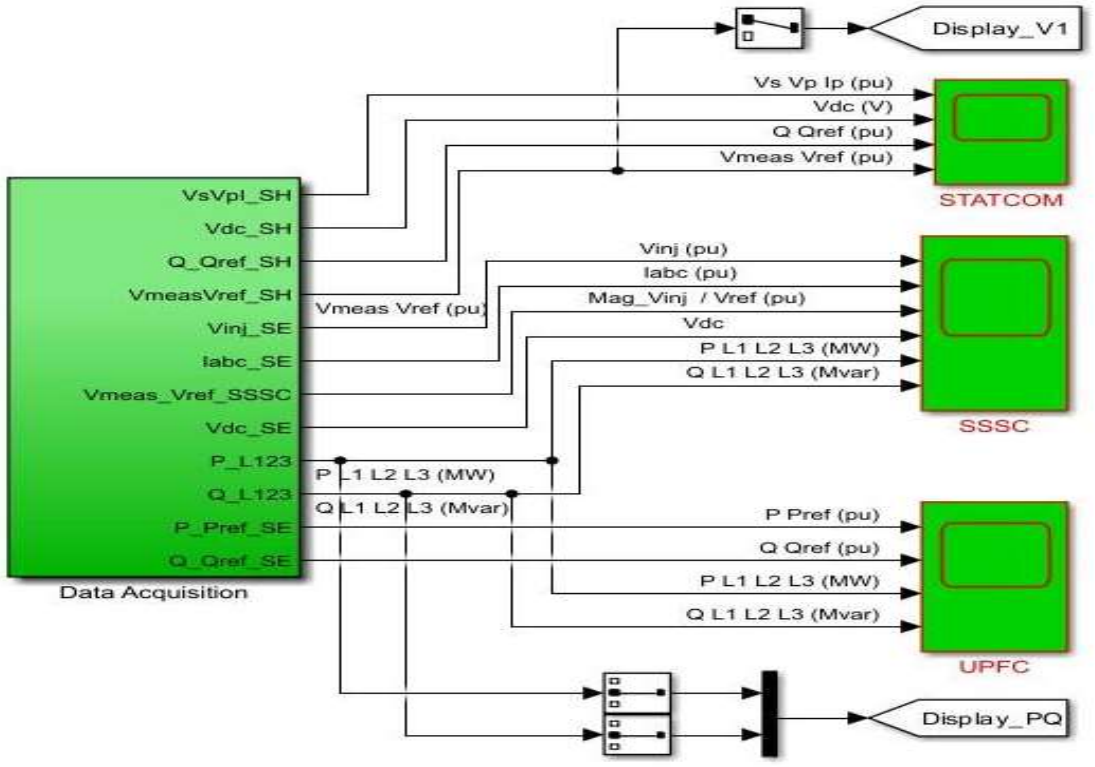

Figure 11 Detailed Model of SCOPE

The detailed model of the scopes demonstrates us about compensators used to display that are: STATCOM, SSSC, UPFC whose simulation results are shown below.

1] STATCOM

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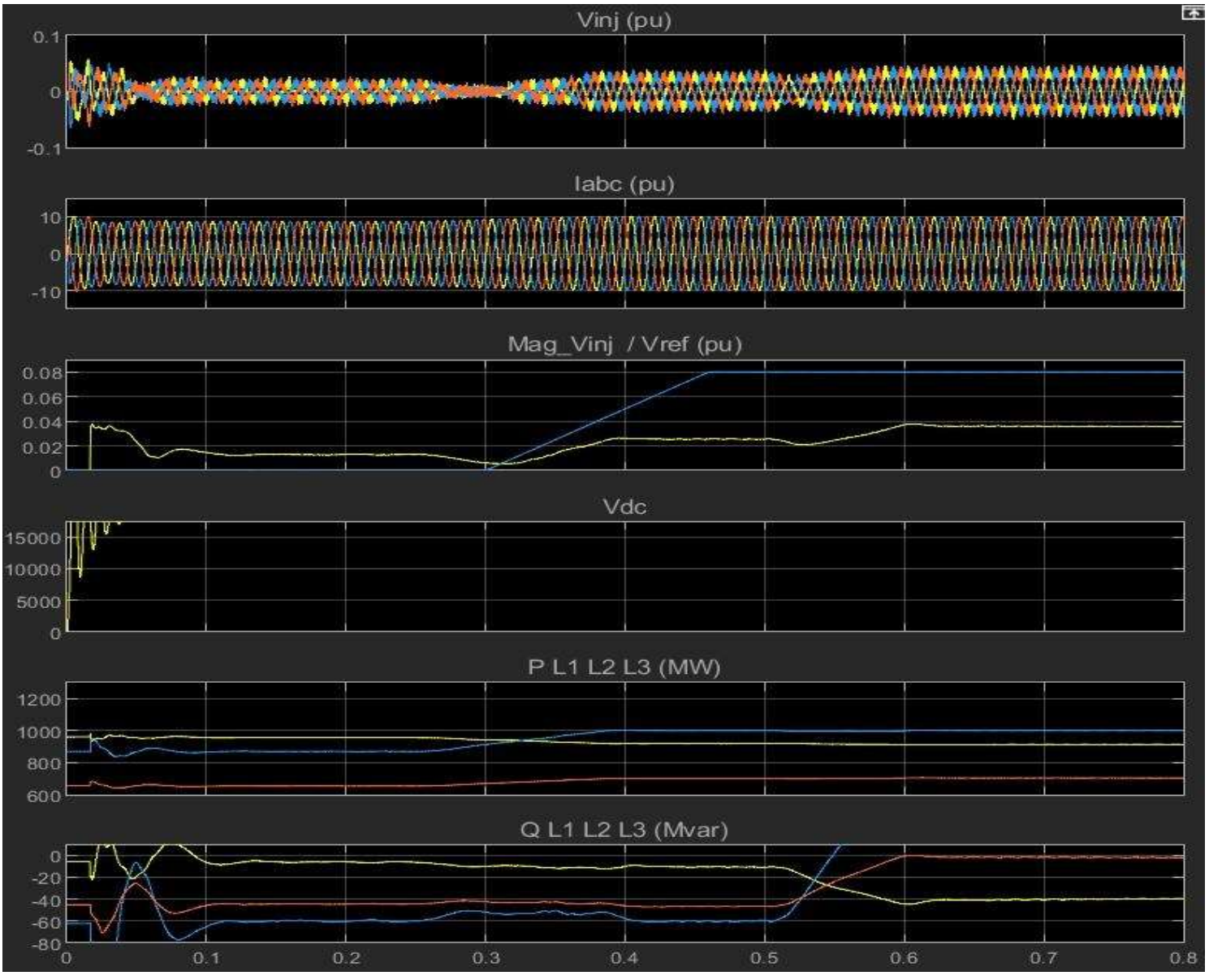
2] SSSC

The structures worked with UPFC thinks about the obviously reliable goal of titanic power affiliations. Evaluations on the effect of changing control settings and UPFC execution on power quality results are composed. In the 22 kV evaluation, a three stage, three wire transmission structure was related with the MATLAB climate utilizing the UPFC's phasor model.



3] UPFC

It has been shown that displaying of UPFC and assessment of force structures worked with UPFC thinks about the obviously reliable goal of titanic power affiliations. Evaluations on the effect of changing control settings and UPFC execution on power quality results are composed. In the 22 kV evaluation, a three stage, three wire transmission structure was related with the MATLAB climate utilizing the UPFC's phasor model. This study examines the show and control of UPFC that will be introduced on a transmission line. It has been shown that displaying of UPFC and assessment of force structures worked with UPFC thinks about the obviously reliable goal of titanic power affiliations. Evaluations on the effect of changing control settings and UPFC execution on power quality results are composed. In the 22 kV evaluation, a three stage, three wire transmission structure was related with the MATLAB climate utilizing the UPFC's phasor model. This study examines the show and control of UPFC that will be introduced on a transmission line.

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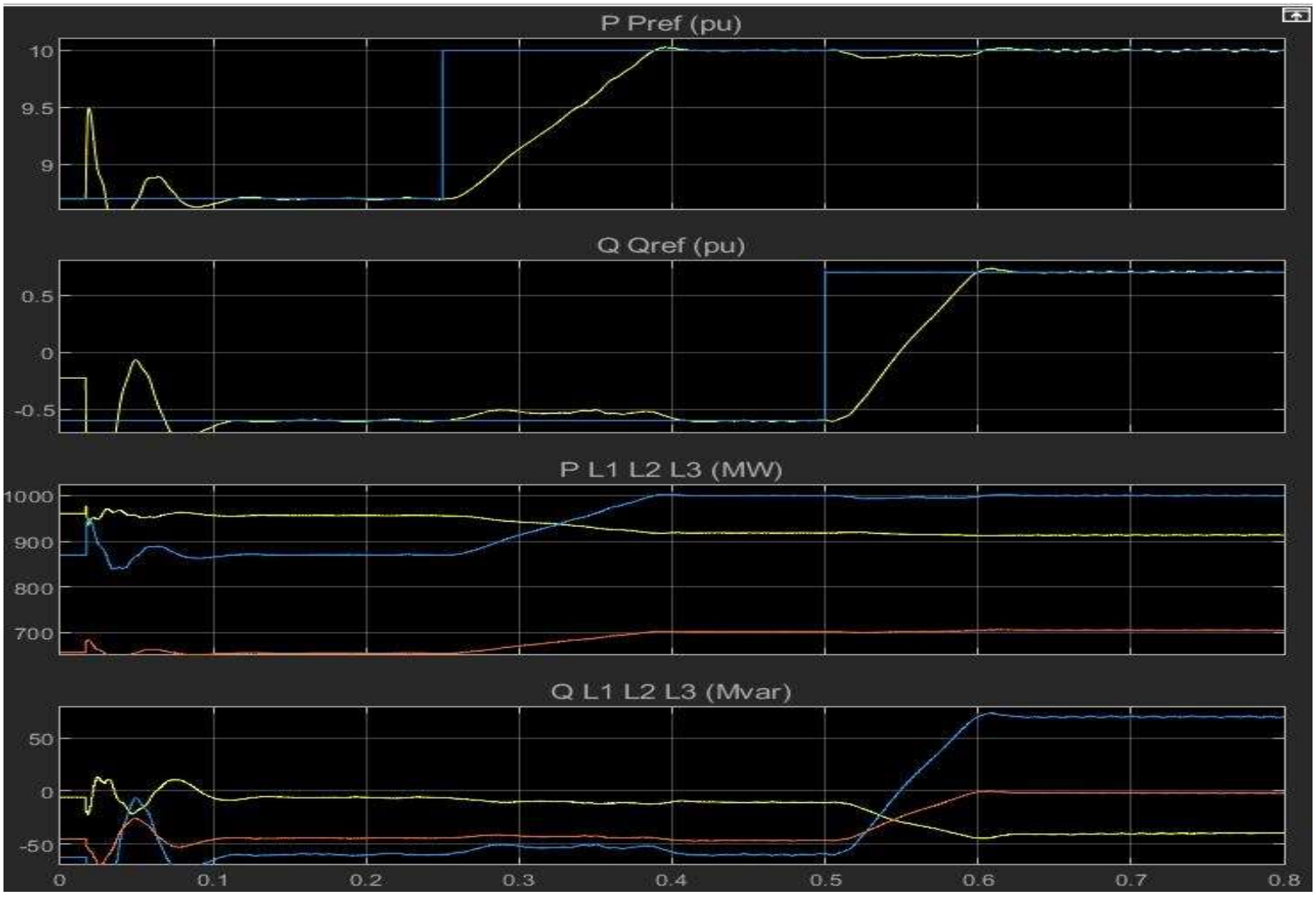

Figure 14 Output of UPFC

4. CONCLUSION

The model of the UPFC coupled to a three-stage framework is replicated in the redirection research utilizing the Matlab Simulink climate. It has been shown that displaying of UPFC and assessment of force structures worked with UPFC thinks about the obviously reliable goal of titanic power affiliations. Evaluations on the effect of changing control settings and UPFC execution on power quality results are composed. In the 22 kV evaluation, a three stage, three wire transmission structure was related with the MATLAB climate utilizing the UPFC's phasor model. This study examines the show and control of UPFC that will be introduced on a transmission line. Results from diversions show how well UPFC controls authentic and open power going through the line.

References

1. *S. Ushkewar, M. Bodke, M. Justin, A. Barghare and B. Dudhawade, "Compensation of Reactive Power in DFIG Based Wind Farm using STATCOM," 2018 Fourth International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB), Chennai, India, 2018, pp. 1-5.*

2. *A. K. Dhulshette, S. Ushkewar, A. A. Khan, H. Rao and N. R. Ahire, "Validation Of Statcom Capabilities Through Modelling And Simulation On Simulink Platform,"* 2018 *Fourth International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB), Chennai, India, 2018, pp. 1-5.*

3. *N. R. Ahire, M. Fernandes, S. Ushkewar and Y. Doke, "Optimal Allocation Of Shunt Compensation And Maximum Loadability Assessment On IEEE-14 Bus Test System," 2018 Fourth International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB), Chennai, India, 2018, pp. 1-4.*

4. *S. Ushkewar, S. Chaube, N. Komawar, N. Tirpude and M. S. Ansari, "Controlled islanding scheme for power system protection: Guidelines and approach: Case study: Proposed Bhopal islanding scheme," 2017 Third International Conference on Advances in Electrical, Electronics, Information, Communication and Bio-Informatics (AEEICB), Chennai, India, 2017, pp. 117-121.*

5. *Sandeep Ushkewar, Nilesh Ahire, A. Raghu, R.Chavan and S.Settanapalli "DC Load Flow Studies of DC link for Power System Planning, International journal of creative thoughts" Vol 6, Issue 2, pp.546-548,2018*