**ABSTRACT**

This project presents a new component within the Flexible AC-Transmission System (FACTS) family called Distributed Power Flow Controller (DPFC). The DPFC is derived from the Unified Power Flow Controller (UPFC). The DPFC can be considered as a UPFC with an eliminated common dc link. The active power exchange between the shunt and series converters, which is through the common dc link in the UPFC, is now through the transmission lines at the third-harmonic frequency.

The DPFC employs the Distributed FACTS (D-FACTS) concept, which is to use multiple small-size single-phase converters instead of the one large-size three-phase series converter in the UPFC. The large number of series converters provides redundancy, thereby increasing the system reliability. As the D-FACTS converters are single-phase and floating with respect to the ground, there is no high-voltage isolation required between the phases.

Accordingly, the cost of the DPFC system is lower than the UPFC. The DPFC has the same control capability as the UPFC, which comprises the adjustment of the line impedance, the transmission angle, and the bus voltage. The results are verified in MAT LAB/SIMULINK.

**LIST OF FIGURES**

**Fig. No DESCRIPTION Page. No**

2.1 A basic UPFC functional scheme 6

2.2 Unified Power Flow Controller 8

2.3 Equivalent circuit of UPFC 10

2.4 UPFC schematic 13

2.5 Uncompensated system 13

2.6 Shunt compensation 14

2.7 Series branch schematic diagram 15

2.8 Phase angle compensation 15

2.9 Combined compensation phasor diagram 15

3.1 Reactive power generation by a STATCOM 18

3.2 STATCOM operating in inductive or capacitive modes 19

3.3 Current controlled block diagram of STATCOM 20

3.4 Voltage controlled block diagram of STATCOM 21

3.5 STATCOM operation in a power system 22

3.6 Phasor diagrams for STATCOM applications 24

3.7 Two machine system with STATCOM 25

3.8 Transmitted power versus transmission

angle characteristic of a STATCOM 26

3.9 STATCOM structure and voltage,

current characteristic 28

3.10 Pulses STATCOM 28

3.11 STATCOM equivalent circuit 29

4.1 Functional model of SSSC 34

4.2 SSSC phasor diagram 35

4.3 Series compensation by SSSC 37

4.4 Flowchart from UPFC to DPFC 40

4.5 DPFC configuration 41

4.6 Active power exchange between DPFC converters 42

4.7 Utilize grounded Y-∆ transformer to

Filter zero-sequence harmonic 43

4.8 Route the harmonic current by using the grounding 44

Of the Y-∆ transformer

4.9 DPFC control block diagram 45

4.10 Block diagram of the series converter control 46

4.11 Block diagram of the shunt converter control 46

4.12 DPFC shunt converter configuration 48

5.1 Simulation circuit diagram of DPFC 50

5.2 DPFC operation in steady-state: line current 51

5.3 DPFC operation in steady-state: series converter voltage 52

5.4 DPFC operation in steady-state: bus voltage and 53

Current at the ∆ side of the transformer

**ABBRIVATIONS**

FACTS : Flexible ac Transmission System.

D-FACTS : Distributed Flexible ac Transmission System.

DPFC : Distributed Power Flow Controller.

UPFC : Unified Power Flow Controller.

STATCOM : Static Synchronous Compensator.

SSSC : Static Synchronous SERIES Compensator.

PWM : Pulse Width Modulator.

PLL : Phase Locked Loop.

**NOMEN CLATURES**

***Vs*** *-* Nominal voltage of grid s.

***Vr*** *-* Nominal voltage of grid r.

**θ** - Transmission angle between grid s and r.

***L*** *-* Line inductance.

***Vsh, max*** *-* Shunt converter maximum ac voltage.

***Ish, max*** *-* Shunt converter maximum ac current.

***Vsh, dc*** *-* Shunt converter dc source supply.

***Ish, ref****,  -* 3rd harmonic current injected by shunt converter.

***Fsw*** *-* Switching frequency for the shunt and series

converter.

***Vse, max***  *-* Maximum ac voltage at line side of series converter.

***Ise, max*** *-* Maximum ac voltage at line side of series converter