APPENDICES

Appendix-I:

Mathematical model design parameters of PV system: \( N_S = 54; \ G_{n,ref} = 1000\text{W/m}^2; \ T_{n,ref} = 25 \degree\text{C}; \ I_m = 6.41\text{A}; \ V_m = 31.2\text{V}; \ P_m = 200\text{W}; \ V_{OC,ref} = 32.9\text{V}; \ I_{SC,ref} = 6.5\text{A}; \ K_i = 0.0032\text{A/}\degree\text{K} \); \( D(t) = 0.1 \) to \( 0.5 \)

Parameters of the dc-dc boost converter topology: \( L_{pv} = 290\mu\text{H} \); \( C_{in} = 250\mu\text{F} \) and \( C_{out} = 330\mu\text{F} \).

Appendix-II:

Parameters involved in design of mathematical model of PV: \( N_S = 54; \ G_{n,ref} = 1000\text{W/m}^2; \ T_{n,ref} = 25 \degree\text{C}; \ I_m = 7.61; \ V_m = 36.3\text{V}; \ P_m = 104\text{KW}; \ V_{OC,ref} = 32.9\text{V}; \ I_{SC,ref} = 68.21\text{A}; \ R_p = 415.405\Omega, \ R_s = 0.221\Omega; K_i = 0.0032\text{A/}\degree\text{K}, K_v = 0.073\text{V/}\degree\text{K} \)

Parameters taken for implementation of the dc-dc boost converter topology: \( L_{pv} = 290\mu\text{H} \);

\( C_{in} = 250\mu\text{F} \) and \( C_{out} = 330\mu\text{F} \).

Parameters taken for grid: 4.4KV, 50Hz, X/R=7

Appendix-III:

Parameters of solar generating system:: \( N_S = 54; \ G_{n,ref} = 1000\text{W/m}^2; \ T_{n,ref} = 25 \degree\text{C}; \)

\( I_m = 6.41\text{A}; \ V_m = 31.2\text{V}; \ P_m = 750\text{W}; \ V_{OC,ref} = 32.9\text{V}; \ I_{SC,ref} = 6.5\text{A}; \ K_i = 0.0032\text{A/}\degree\text{K}. \)

Parameters of dc-dc boost converter: \( L_{pv} = 290\mu\text{H} \); \( C_{in} = 250\mu\text{F} \) and \( C_{out} = 330\mu\text{F} \)

Appendix-IV:

Parameters of the Islanded Microgrid System: \( V_{dc} = 1500\text{V}; \ f = 50\text{Hz}; \ L_f = 1\text{mH}; \ R = 5\Omega; \ L = 4\text{mH}; \) Power Factor = 0.95 lagging; \( P = 108\text{KW}; \ Q = 32 \text{ Kvar}; \ k_p = 0.005; k_i = 30 \)

SOFC Data: SOFC Stack Output Voltage = 807 V; SOFC Stack Output Current = 70 A;

SOFC Stack Output Power = 60 KW; SOFC Stack Output Voltage After Boost = 1500 V;
SOFC Stack Output Current After Boost = 66 A; SOFC Stack Output Power After Boost = 100 KW; Number Of cells in series = 675

Appendix-V

DC Source: $V_{dc} = 2500$ V

Inverter: Inverter-1 rating = 600 KVA; Inverter-2 rating = 500 KVA

Inverter Filter: $L_f = 5$ mH; $C_f = 300$ μF

Transformer: Nominal power = 1600 KVA; Nominal power = 2500 KVA Nominal Frequency = 60 Hz; $V_{1_{rms}}(Ph - Ph) = 1450$ V; $V_{2_{rms}}(Ph - Ph) = 550$ V; $R_2$ (PU) = 0.02/25; $L_2$ (PU) = 0.02; $R_m$ (PU) = 100; $L_m$ (PU) = 100

Transmission line: $R_T = 1$ Ohm; $L_T = 1$ μH; $C_T = 90$ μF

Load-1: $P_{constant} = 80$ KW; $Q_{constant} = 10$ KVAr; $I_{non-linear}$ (rms line current) = 15 A; $P_{(1-Ph)} = 10$ KW; $P_{Switched} = 10$ KW; $Q_{Switched} = 10$ KVAr.

Load-2: $P = 20$ KW; $Q = 10$ KVAr

Appendix-VI

DC Source: $V_{dc} = 2500$ V

Inverter: Inverter-1 rating = 600 KVA; Inverter-2 rating = 500 KVA

Inverter Filter: $L_f = 5$ mH; $C_f = 300$ μF

Transformer: Nominal power = 600 KVA; Nominal power = 500 KVA Nominal Frequency = 60 Hz; $V_{1_{rms}}(Ph - Ph) = 1500$ V; $V_{2_{rms}}(Ph - Ph) = 500$ V; $R_2$ (PU) = 0.02/25; $L_2$ (PU) = 0.02; $L_1$ (PU) = 0.02;

Transmission line: $R_T = 0.09$ Ω/km; $L_T = 0.04$ Ω/km; $C_T = 90$ μF

Load-1: $P_{constant} = 200$ KW; $Q_{constant} = 90$ KVAr; $I_{non-linear}$ (rms line current) = 15 A; $P_{(1-Ph)} = 10$ KW; $P_{Switched} = 10$ KW; $Q_{Switched} = 10$ KVAr.

Load-2: $P = 20$ KW; $Q = 10$ KVAr
Appendix-VII

\textit{PV:} Parallel strings = 32; Series connected module per string = 7

\textit{PV module:} Maximum power (W) = 309.856; \( N_{\text{cell}} = 72; \) \( V_{OC} = 44.6 \) V; \( I_{SC} = 8.85 \) A; \( V_{mp} = 36.8 \) V; \( I_{mp} = 8.42 \) A Temp. coefficient of open circuit voltage = -0.33 %/deg.C; Temp. coefficient of short circuit current = 0.063797 %/deg.C

\textit{PV model parameters:} \( I_L = 8.9128 \) A; \( I_o = 1.0221 \times 10^{-10} \) A; Diode identity factor \((\alpha) = 1.05753; \) \( R_{sh} = 427.776 \Omega; \) \( R_s = 0.29116 \)

\textit{SOFC parameters:} Stack power (nominal) = 50 KW; Stack power (maximal) = 120.4 KW; Fuel cell resistance = 0.66404 \( \Omega \); Nerst voltage of one cell = 1.1342 V; Hydrogen = 99.25%; Oxidant = 70.4%; Nominal fuel consumption = 501.8 slpm; Nominal air consumption = 1194 slpm; Exchange current = 0.91636 A; Exchange coefficient = 0.26402; Fuel composition = 99.95%; Oxidant composition = 21%; Fuel flow rate (nominal) = 417.3 lpm; Air flow rate (nominal) = 2100 lpm; System temperature = 338 Kelvin; Fuel supply pressure = 1.5 bar; Air supply pressure = 1 bar.

\textit{Boost converter:} PV-Boost rating = 100 KW; FC-Boost rating = 50 KW

\textit{DC filter:} \( L_f = 0.4 \) mH; \( C_f = 2100 \mu F \)

\textit{VSC:} VSC-PV rating = 100 KW; VSC-FC rating = 50 KW

\textit{AC filter:} \( L_f = 1.2 \) mH; \( C_f = 300 \mu F \)

\textit{Isolation transformer:} Nominal power-PV = 100 KVA; Nominal power-FC = 50 KVA; Nominal Frequency = 60 Hz; \( V_{1\,\text{rms}}(Ph - Ph) \) (PV) = 230 V; \( V_{1\,\text{rms}}(Ph - Ph) \) (FC) = 1500 V; \( R_1 (PU) = 0.02/25; \) \( L_1 (PU) = 0.02; \) \( V_{2\,\text{rms}}(Ph - Ph) \) (PV) = 230 V; \( V_{2\,\text{rms}}(Ph - Ph) \) (FC) = 230 V; \( R_2 (PU) = 0.02/25; \) \( L_2 (PU) = 0.02; \) \( R_m (PU) = 100; \) \( L_m (PU) = 100 \)

\textit{Transmission line:} \( R_T = 0.04 (\Omega/\text{km}); \) \( L_T = 0.13 (\Omega/\text{km}); \) \( C_T = 90 \mu F \)
LIST OF PUBLICATIONS

I. International Journals:


**II. International Conferences:**


15. **S Choudhury**, P K Rout, “Comparative Study of M-FIS FLC and Modified P&O MPPT Techniques under Partial Shading and Variable Load conditions” *International Conference on Electronics, Energy, Environment, Communication, Computer, and Control. (INDICON 2015), New Delhi, India (Published in IEEE Digital Explorer).*

