

Simulation Topology and Important Parameters

This document provides the topological diagram for the simulation of the bulk grid and the 82-node DER cluster, detailing DER capacity parameters, as well as system and control parameters.

The topological diagram for the bulk grid comprising 6 DER clusters is shown in Fig. 1:

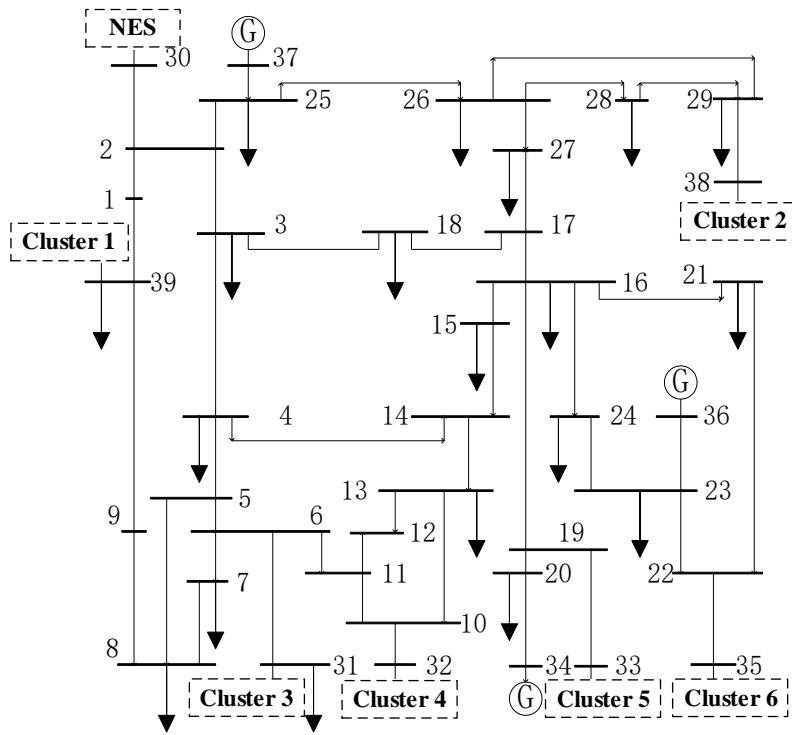


Fig. 1 Topology diagram of bulk grid

The cluster 6, an 82-node DER cluster, is selected as a representative for analysis, and its topological diagram is shown in Fig. 2:

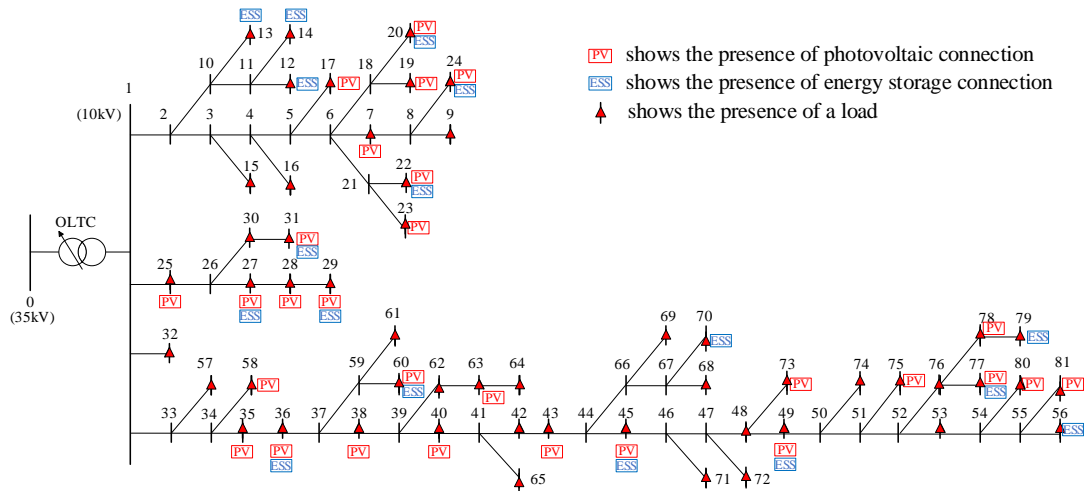


Fig. 2 Topology diagram of 10kV DER cluster

The capacity parameters of the controllable PV converters and ES converters are shown in Table I:

Controllable Resources	Nodes	Controllable Capacity/MVA
Energy Storage Converter	12、13、14、20、22、24、 27、29、31、36、45、49、 56、60、70、77、79	0.2
	22、25、27、36、38、58、 63、73、77、78	0.06
Photovoltaic Converter	23、24、31、43、60、75、81	0.12
	17、20、28、35、45、80	0.24
	7、19、29、40、49	0.36

The system and control parameters are shown in Table II:

Parameter Name	Value
Maximum unbalanced power	16400KW
System inertia	650 MW • s/Hz
Initial P/f droop coefficient for each DER cluster	6MW/Hz
Overall P/f droop coefficient for new energy station	10MW/Hz
Governor deviation coefficient for thermal power plant	3.333%
Turbine equivalent inertia time constant	6s
Turbine characteristic coefficient	0.0999
Optimization period	20s
Optimization time scale	0.5s
Frequency discrete time scale	1ms
P/f droop coefficient optimization granularity	20s
Q/V droop coefficient optimization granularity	20s
Iterative convergence criterion value	0.001MW/Hz
Upper/lower limits of the stored energy of ES	[0.05,0.95]
Charging/discharging efficiency of ES	95%
The number of partitions in the adaptive McCormick technique	3
The convergence criterion of the adaptive McCormick technique	0.0001
The initial contraction factor ε^1 of the adaptive McCormick technique	0.02
The contraction factor τ of the adaptive McCormick technique	0.01

The parameter configuration for the Sequential Quadratic Programming (SQP) algorithm with multiple starting points in MATLAB is as follows:

TABLE III

PARAMETER CONFIGURATION FOR THE SQP ALGORITHM WITH MULTIPLE STARTING POINTS

Parameter Name	Value
Number of starting points	500
Maximum number of iterations	1000
Optimality Criterion	0.0001
Step size tolerance	0.0001